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Directorate of Urban, Regional Policy and Strategic Planning, Planning and Development Department, Government of Sindh

"Preparation of Development Master Plans for Twelve (12) Major Secondary Cities of Sindh (Package-1 Khairpur, Ghotki, Rohri and Mirpur Mathelo)"

DRAFT STRATEGIC DEVELOPMENT PLAN REPORT

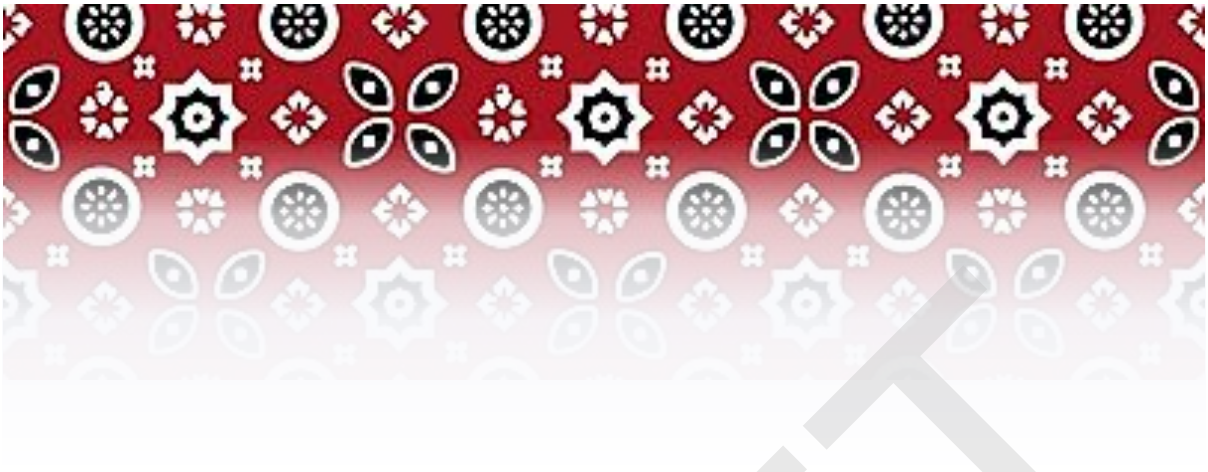
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SECTION - 1: STRATEGIC DEVELOPMENT PLAN – AN OVERVIEW

1.1 Project Background

The Government of Sindh established the Directorate of Urban, Regional Policy, and Strategic Planning to provide technical assistance to the Planning and Development Department of the Government of Sindh on policies, plans, issues, programs, projects, and schemes related to urban revitalization and development.

So far, Directorate has completed 17 Development Master Plans of District Head Quarters / Secondary cities of Sindh. In order to maximize the coverage of the Master Plans for developing other important secondary towns of Sindh as engines of growth, development master plans of the following 12 major secondary cities of Sindh are planned to be prepared through hiring of consulting firms i.e., Kotri, Hala, Moro, Tando Adam, Khairpur, Rohri, Mirpur Mathelo, Ghotki, Shikarpur, Jacobabad, Kashmore and Kambar. This activity will be beneficial for developing the regional plans of different urban/ peri-urban centres of Sindh.

The scheme will be carried out in Three (03) different packages i.e.

- **Package - 1.** Khairpur, Ghotki, Mirpur Mathelo and Rohri
- **Package - 2.** Shikarpur, Kandhkot, Jacobabad and Kambar
- **Package - 3.** Kotri, Hala, Tando Adam and Moro

In line with this mission, we are proud to announce the initiation of the "Development Master Plans Preparation Project" for Twelve (12) Major Secondary Cities of Sindh, specifically Package-1, which includes Khairpur, Ghotki, Mirpur Mathelo, and Rohri. This significant endeavour has been entrusted to Asian Consulting Engineers Pvt. Ltd., following a comprehensive assessment of their technical and financial proposals and a compelling presentation to our esteemed client. The formal agreement for this project was formally executed on March 31, 2023.

The four cities of Package 1 are located in Sukkur Division which is a significant administrative unit and comprises of multiple districts. Khairpur city is located in District Khairpur, Ghotki and Mirpur Mathelo city is in District Ghotki and Rohri city is in District Sukkur. Each district has its own Deputy Commissioner (DC), who is responsible for the overall administration and law and order within the district. Within each district, there are several talukas. These talukas are responsible for local administration, revenue collection, and land record maintenance. The four cities Khairpur, Ghotki, Mirpur Mathelo and Rohri are located in their respective taluka's.

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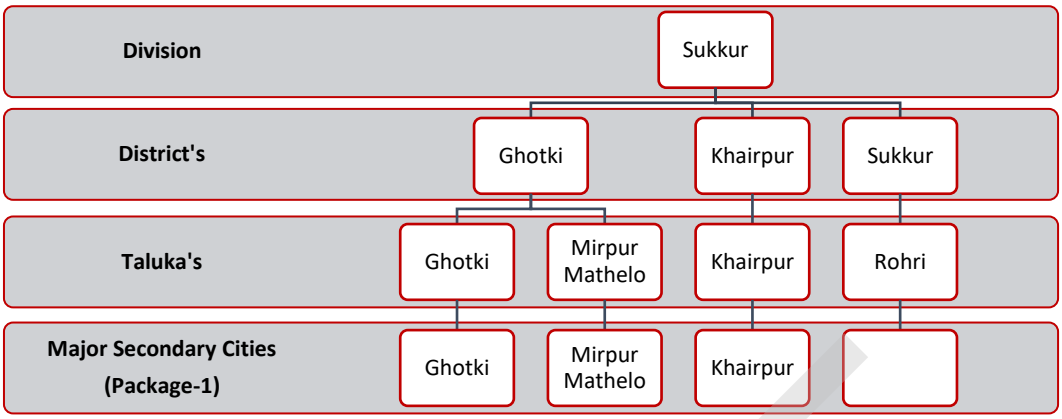


Figure 1-1, Administrative Division of the Package 1 Cities

Source: *The Consultant Team*

1.2 General Planning Issues

Despite its significant contribution to the national GDP, the province of Sindh has not received the development funding it deserves. The Directorate of Urban, Regional Policy and Strategic Planning (DURPandSP) serves as a platform through which grassroots development strategies are formulated by professionals to improve the quality of life for residents. An extensive review of the existing literature reveals several critical issues impacting Sindh's development:

- The lack of a comprehensive and sustainable urban planning policy and regulatory framework has hindered effective urbanization across Sindh, leading to unchecked, haphazard growth in cities.
- Without an updated housing policy that supports sustainable and smart growth, the province faces inadequate housing solutions that fail to meet the demands of its growing population.
- Fragmented coordination among the numerous institutions responsible for urban development has led to ineffective planning and execution of development projects.
- Past master and development plans have seen minimal implementation due to a lack of robust enforcement mechanisms, stalling urban development progress.
- Local cultural preferences and traditional settlement patterns often resist modern urbanization efforts, posing challenges to implementing contemporary urban strategies.
- Many district headquarters face critical deficiencies in municipal infrastructure, particularly in essential services such as water supply, wastewater management, and solid waste management.

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- The province lacks comprehensive spatial and non-spatial databases necessary for effective planning, monitoring, and management of development initiatives.

1.3 Project Objectives

The project's primary objectives revolve around establishing a comprehensive policy framework aimed at enhancing the holistic development and governance of Sindh's major secondary cities, specifically Khairpur, Ghotki, Mirpur Mathelo, and Rohri. This strategic initiative is driven by the need to pinpoint strategic areas and corridors that will guide the cities' future spatial expansion while fostering environmental sustainability and equitable economic progress.

Key objectives of the project include:

- Crafting a cohesive policy framework that seamlessly integrates physical, environmental, social, and economic aspects to drive a well-rounded urban development approach.
- Identifying areas for future spatial expansion that are conducive to environmentally sustainable development, with a keen focus on minimizing ecological impacts and optimizing resource use.
- Promoting economic growth that benefits all strata of society, ensuring that the fruits of development are shared inclusively among the population.
- Enhancing the governance mechanisms within these cities to foster more efficient, transparent, and responsive administrative structures.

1.4 The Strategic Development Plan Output

The strategic development plan for Sindh's secondary cities charts a roadmap for sustainable urban growth, infrastructure enhancement, and quality of life improvements. Each city is envisioned with a cohesive, unique vision aligned with regional goals, emphasizing balanced urbanization, economic vitality, social equity, and environmental resilience. Detailed land use and zoning guidelines prevent sprawl and protect sensitive areas, while infrastructure plans prioritize efficient transport and connectivity, encouraging non-motorized options for pedestrian-friendly environments.

Housing strategies focus on affordable solutions and essential services like schools and healthcare, while economic zones aim to attract investments, support local industries, and create jobs. Environmental sustainability is central, with measures for pollution control, waste management, and climate resilience. Social inclusivity promotes equitable access and community engagement, preserving cultural heritage.

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The plan outlines an actionable framework with phased goals, clear responsibilities, and timelines, supported by monitoring mechanisms for adaptive management. Policy recommendations also strengthen local governance and capacity-building, guiding Sindh's secondary cities toward vibrant, inclusive, and resilient futures.

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SECTION - 2: OVERVIEW OF KHAIRPUR AND ITS ENVIRONMENT

2.1 Introduction

In this section, the current situation of Khairpur city and its surrounding district is explained. This section outlines the current demographic, climatic, geographic, cultural, and historical features of Khairpur city and its district. It highlights the area's strategic location, environmental conditions, and rich heritage, providing a foundation for understanding its existing situation and development potential.

2.2 District at Glance

The Khairpur District is one of the districts of Sukkur division. It is a place of tremendous historical significance for the subcontinent. The district' s history, in fact, dates back to 3300 BC, when the ancient Kot Diji, one of the oldest civilizations known to history, was a thriving civilization in the region. It is the southwestern district of Sukkur Division. Khairpur District consists of 8 talukas: Khairpur (District Headquarter), Gambat, Kot Diji, Mirwah, Faiz Ganj, Nara, Kingri, and Sabho Dero.

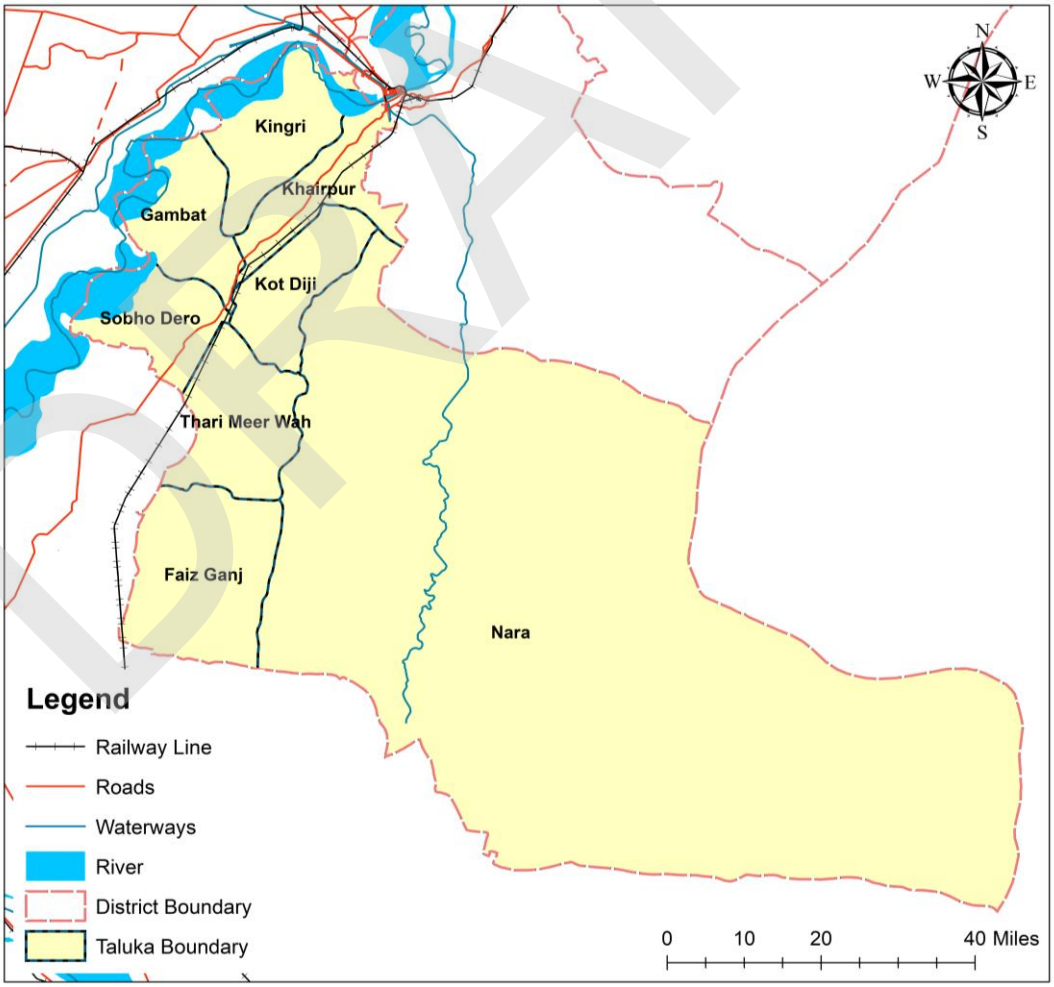


Figure 2-1, Location Map of Khairpur District

Source: *The Consultant Team*

2.2.1 Geographical Location

Khairpur District is located in the northern side of Sindh province. It lies between 26° 09′ and 27° 42′ North latitudes and 68° 10′ and 70° 10 ′ East longitudes. The district is bounded on the North by Shikarpur and Sukkur districts, on the East by India, on the South by Sanghar and Shaheed Benazirabad districts and on the West by Naushahro Feroze and Larkana districts. The district headquarter, Khairpur city, is located along the National Highway (N-5), which serves as a major transportation artery connecting Karachi to Peshawar.

2.2.2 Topography, Geology and Soils

Khairpur District features a diverse topography characterized by a combination of fertile alluvial plains and sandy desert hills. The district is predominantly flat due to its location along the Indus River, with a significant portion of its land suitable for agriculture, enriched by sediment deposits from the river. The western part consists of cultivated plains, while the eastern region is marked by sandy hills and dunes, known locally as "Bhit"[1].This varied landscape includes steep slopes and low-lying areas called Patt, contributing to the district's unique geographical features. Additionally, the presence of canals like Rohri and Mir Wah further supports agricultural activities in the region.

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[1] Ansari, K. A., Malik, A. R., Mahar, A. R., and Abro, S. A. (2017). Effects of topography and monsoon rain on vegetation composition of sandy arid areas of District Khairpur Mir's. Sindh University Research Journal-SURJ (Science Series), 49(3), 639-642

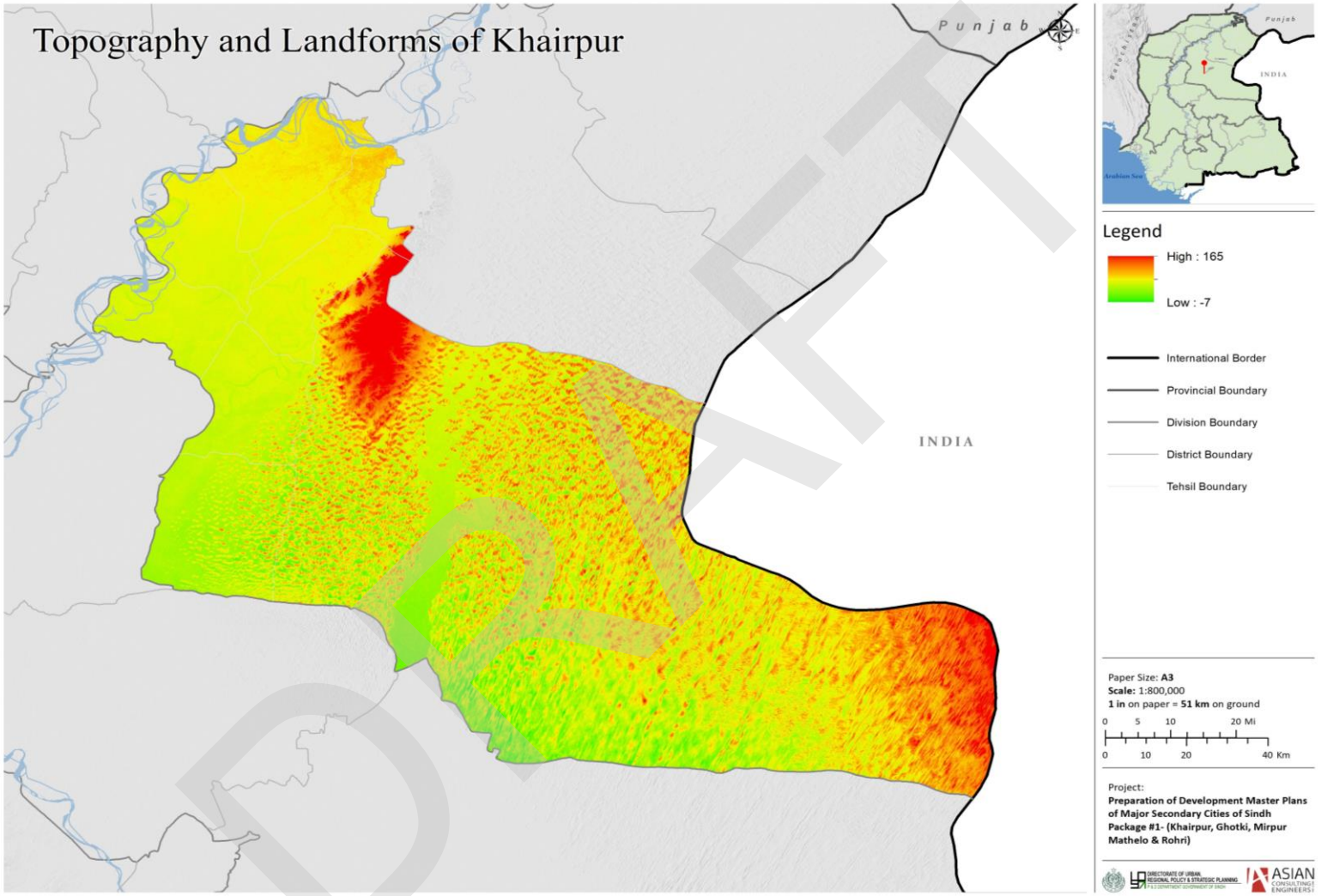


Figure 2-2, Topography and Landform of Khairpur District

Source: *The Consultant Team*

Geologically, Khairpur District primarily consists of quaternary sedimentary and volcanic rocks, with a small northern section of tertiary rocks. The district can be divided into three main zones: the active floodplain of the Indus River, an area irrigated by a network of canals (including Khairpur West, Rohri, Khairpur East, and Nara canals), and the desert zone known as Nara, which features piedmont plains. The fertile canal-irrigated area supports year-round agriculture, while the Nara desert zone includes low-lying limestone hills and sand dunes, creating an oasis-like environment near the Nara canal. This diverse topography contributes to the district's agricultural productivity and unique landscape.

While, the soils of Khairpur District can be categorized into four main types: loamy and stratified soils found in the young flood plains, loamy and clayey soils present in the older river plains, rock outcrops with patchy heterogeneous soil cover in the western mountainous region, and rolling to hilly sandy soils typical of the Aeolian deserts. The fertile areas near the Indus River support extensive agriculture, while the desert regions consist of less fertile soils influenced by the surrounding sandy terrain. This diverse soil composition plays a crucial role in determining land use and agricultural productivity in the district.

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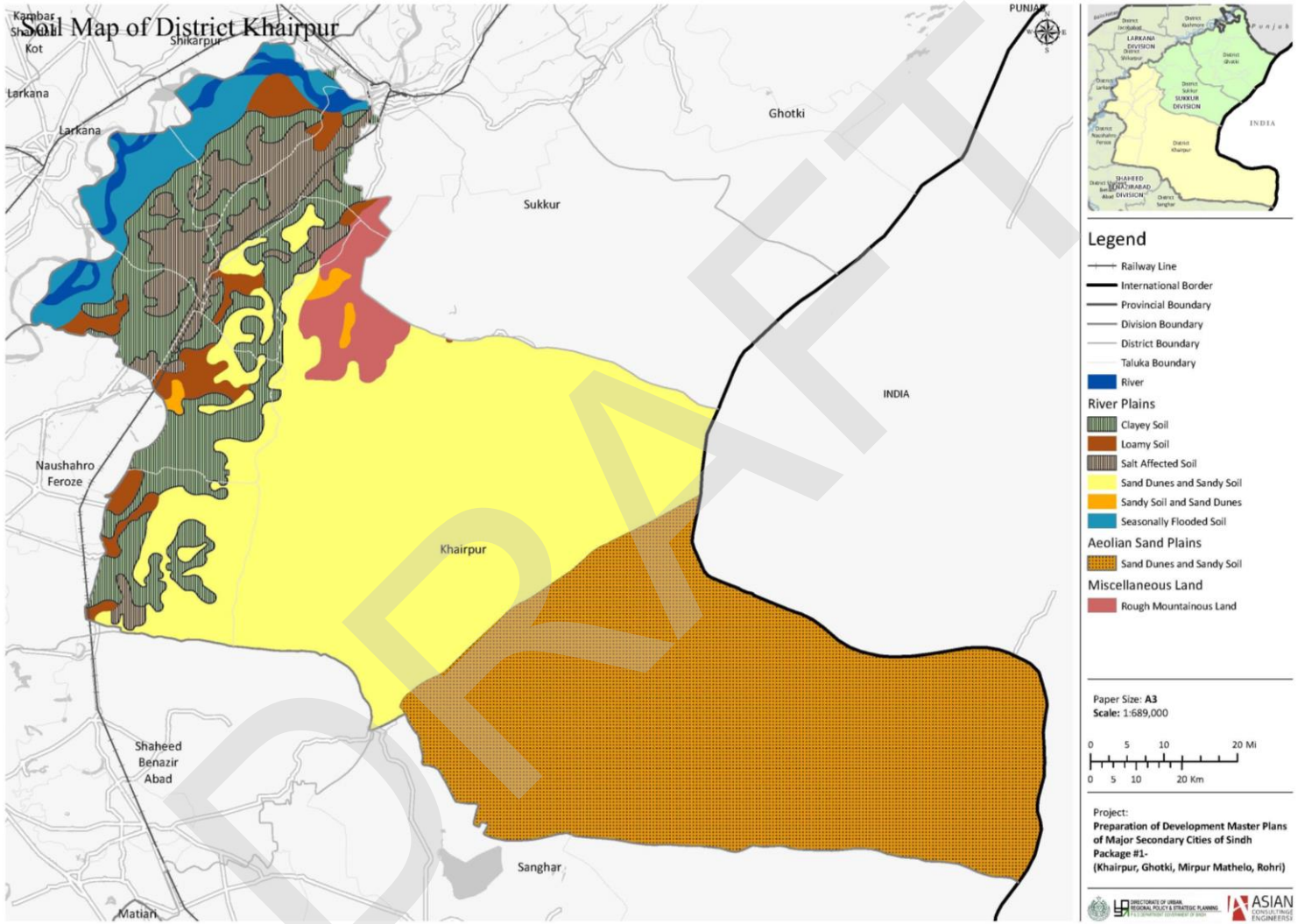


Figure 2-3, Soil Map of District Khairpur

Source: *The Consultant Team*

2.2.3 Climate

Khairpur District has a subtropical desert climate, characterized by high temperatures and low annual rainfall. The average yearly temperature hovers around 32.38° C (90.28° F), with summer months, particularly June, often reaching extreme highs of approximately 44.92° C (112.86° F). Winters are relatively mild, with January being the coldest month, averaging about 13.77° C (56.79° F). The district experiences clear skies and dry conditions for most of the year, contributing to its arid landscape.

Rainfall in Khairpur is minimal, averaging around 15.9 millimetres (0.63 inches) annually, typically occurring during the monsoon season from July to September. This limited precipitation results in about 19.9 rainy days per year, which can impact agricultural activities in the region. However, the fertile areas near the Indus River and the extensive network of irrigation canals allow for productive farming despite the overall dryness of the climate. The combination of high temperatures and low humidity creates a unique environment that influences both the natural landscape and the livelihoods of the local population[2].

2.2.4 Demography

Khairpur District covers approximately 15,910 sq. km and had a population of 2,597,535 persons in 2023, consisting of both rural and urban populations. The rural portion has a population density over twice that of the urban portion (68% vs 32%) in 2023, reflecting the fact that the majority of the population lives in rural areas. The growth rates of the district, as observed in past census reports, indicate a continuous decline from 4.50% to 1.29%, reflecting an overall 71% decrease in the growth rate from 1961.

Table 2-1, Intercensal Population Distribution of District Khairpur

Year	Population	Average Annual Growth Rate (%)
2023	2,597,535	1.29
2017	2,405,190	2.34
1998	1,547,751	2.71
1981	981,190	3.60
1972	724,935	3.20
1961	500,258	4.50
1951	319,543	-

Source: *Pakistan Bureau of Statistic*

The district is divided into 8 talukas, with Nara taluka being the largest in terms of area and smallest in terms of population. Whereas Khairpur taluka having

[2] *Pakistan Almanac*

the highest population and Sobho Dero is the smallest in terms of area. Main towns of the district are Khairpur, Kot Diji, Faiz Gunj, Nara Town, Luqman, Shah Latif, Ranipur, Gambat, Khuhra, Jado Wahan, Piryaloi, Bhurgari, Bukhari, Kingri, Hingroja, Kumb, Subhodero, Therhi, and Tando Masti Khan. Further details of taluka's population are mentioned below:

Table 2-2, Taluka's Population Distribution of District Khairpur

Taluka	Area (sq.km)	Population (2023)	Household Size (2023)	Growth Rate (1998-2017)	Growth Rate (2017-2023)
Khairpur	585	465,233	5.3	2.5	0.92
Gambat	582	286,129	6.0	2.22	1.40
Kot Diji	520	385,872	6.1	2.26	1.71
Mirwah	631	379,615	5.6	2.36	1.23
Faiz Ganj	946	243,254	5.1	2.26	1.38
Nara	11,611	173,968	5.2	2.95	1.34
Kingri	531	370,304	6.2	2.11	1.42
Sobho Dero	504	293,160	6.1	2.33	1.06

Source: *Pakistan Bureau of Statistic*

2.2.5 Ethnicity and Culture

Khairpur District, renowned as the hub of civilization, culture, trade, and commerce, has gained political and economic significance due to its strategic location within Sindh[3]. The majority of the population, comprising 96.86%, adheres to the Muslim faith, followed by Hindus at 2.93%. Sindhi serves as the predominant spoken language, accounting for 95.15% of the population. Other languages spoken in the district include Balochi (2.70%), Punjabi (1.16%), and Urdu (1.7%). A minority of individuals communicate in Siraiki[4].

Culturally, Khairpur is known for its historical significance and landmarks, including the Talpur dynasty, which established its rule in the late 18th century. The influence of Sufi traditions is evident in the local customs and practices, with notable figures such as Sachal Sarmast, an 18th-century Sufi poet, being celebrated in the area. The district also hosts various cultural events that showcase its artistic heritage, including handicrafts and folk art. This blend of religious practices, languages, and h istorical influences creates a vibrant community that is reflective of both its Islamic roots and the rich cultural heritage of Sindh.

2.2.6 Major Linkages

Khairpur District is strategically positioned with significant transport linkages that facilitate connectivity within the region and beyond. The district is served

[3] http://farmingpak.blogspot.com/2012/09/in-khairpur-tutorial-benefits-date.html
[4] http://www.khairpur.gos.pk/history.asp

by a network of roads that connect it to major cities such as Sukkur and Rahim Yar Khan, enhancing trade and mobility for residents. The National Highway (N-5), which runs from Torkham at the Pakistan-Afghanistan border to Karachi through the district, serves as a vital corridor linking Khairpur to other major cities in Pakistan. Additionally, the district is in close proximity to Sukkur Airport, approximately 32 kilometres away, providing domestic flight options to major cities like Karachi, Islamabad, and Lahore. It is also served by a Mainline (ML-1) Railway network that connects it to the main line of Pakistan Railways, further facilitating the movement of goods and people across different regions. Overall, the combination of major roads, and a robust railway network positions Khairpur as an important hub for trade and transportation in the Sindh province.

2.3 Khairpur City

2.3.1 Historical Background

The Khairpur Municipal Committee came into existence in 1959 under Basic Democracies Ordinance 1959, when the population of Khairpur was only a few thousands. The population increased due to development of city and influx of people from rural areas to urban areas[5].

Khairpur "The City of Dates", is the headquarter of Khairpur District, having a population of 191,044 according to 2023 census. Commonly known as Khairpur Mirs, the city was chosen to serve as the Mirs of northern Sindh. It is located 11 miles (18 km) south of the Indus River along the Khairpur East Canal on National Highway N-5, which originates from Torkham (Pakistan-Afghanistan border) and runs via Peshawar, Islamabad, Lahore, Multan, and Hyderabad on its way to Karachi. Khairpur face a severe threat of floods owing to passage of River Indus[6].

It serves as a communication hub and has rail and road connections to Peshawar and Karachi as well as with almost all the major Pakistani cities and towns. The National Highway, Railway line, Rohri and Mirwah Canal passing thorough Khairpur city from its east and west, including Khairpur Special Economic Zone (KSEZ) is here and which has increased its importance in view of trade, commerce, and socio-economic links with other parts of the country, also part of China-Pakistan Economic Corridor (CPEC). Following the creation of Pakistan in 1947, the city underwent industrial development, adding factories for the manufacture of textiles, silk, leather, and carpets as well as sugar and bread.

Historical and Religious places in Khairpur city are Faiz Mahal, Garhi Pul, Dargah Syed Bachal Shah Buhkhari, Bara Alam, many temples of Hindu and churches of Christian communities.

[5] https://mckhp.gos.pk/about?id=local
[6] https://srso.org.pk/flood-2022/reports/Flood%20Response%20Report-22-sept-2022.pdf

The important places in the city are District Central Jail, Railway station, District and Session Judge Courts, Radio Pakistan, Sachal Sarmast Library, Gymkhana, Shaheed Benazir Bhutto Open Air Theatre, NADRA mega centre and Nusrat Bhutto Secretariat (one unit) etc. Shah Abdul Latif University was established in 1975 as a branch of the University of Sindh, and it received university status in 1987.



Figure 2-4, Faiz Mahal



Figure 2-5, Shah Abdul Latif University

Source: *The Consultant Team*

2.3.2 Existing Institutional Capacity and Administrative Gaps

A. Housing

The housing sector in Khairpur is governed by a multi-tiered institutional framework comprising provincial authorities, development agencies, and local administrative bodies. Each entity operates within defined legal mandates to address housing provision, urban planning, and infrastructure development.

1. Sindh Housing and Town Planning Department

The department serves as the apex policy-making body for urban development across Sindh. Its primary responsibilities include formulating provincial housing strategies, preparing regional master plans, and regulating land-use allocations. As the supervisory authority for development bodies like SDA and SKAA, it oversees the implementation of large-scale housing projects, including those funded through international partnerships. The department also plays a pivotal role in coordinating federal-provincial housing initiatives such as the Naya Pakistan Housing Programme (NPHP), ensuring alignment with national urban development goals.

Resource Allocation:

- Annual development fund allocations from Sindh Government
- Federal grants under programs like Naya Pakistan Housing Programme (NPHP)
- International funding (World Bank, UN-Habitat) for affordable housing initiatives

Operational challenges include:

- Limited field offices in secondary cities like Khairpur, necessitating dependence on local administrations.
- Ineffective coordination with municipal committees and development authorities, resulting in project delays.
- Centralized decision-making processes that hinder timely approvals.
- Suboptimal utilization of geospatial technologies for urban monitoring.

2. Sindh Building Control Authority (SBCA)

SBCA functions as the regulatory body for construction standards and building safety across the province. Its operational purview includes technical review of architectural plans, issuance of construction permits (NOCs), and structural inspections during project execution. The authority maintains enforcement powers to demolish illegal constructions and penalize violations of building bylaws. In rapidly urbanizing areas like Khairpur, SBCA' s role in preventing unplanned vertical expansion and ensuring seismic compliance is particularly critical.

SBCA's organizational capacity is as follow;

Funding Sources:

- Processing fees for plan approvals and NOCs
- Penalties from regulatory violations

Technical Resources:

- Teams of qualified inspectors and structural engineers
- Legal support for enforcement actions

Performance limitations include;

- Insufficient field staff for effective monitoring of construction activities.
- Bureaucratic hurdles in enforcement against illegal buildings.
- Vulnerability to corrupt practices in approval processes.

3. Sindh Katchi Abadis Authority (SKAA)

SKAA specializes in the regularization and upgrading of informal settlements through a rights-based approach. Its work involves conducting cadastral surveys of Katchi Abadis, processing lease documentation to grant tenure security, and coordinating infrastructure upgrades in regularized areas. The authority serves as an intermediary between informal communities and line departments, facilitating access to water, sanitation, and social services post-regularization.

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Its resource profile is as follow,

Financial Basis:

- Provincial budget allocations
- Revenue from lease documentation fees

Implementation Structure:

- Field survey teams for settlement mapping
- Community engagement units

Institutional Weaknesses:

- Chronic underfunding for post-regularization infrastructure development.
- Outdated settlement data affecting policy formulation.
- Protracted lease processing timelines discouraging formalization.

B. Education

The education ecosystem in Khairpur involves coordinated efforts across provincial departments, district offices, and specialized foundations. While these entities possess distinct mandates and resources, systemic gaps in infrastructure, governance, and service delivery persist.

1. Sindh School Education and Literacy Department (SELD)

As the primary policymaker for K-12 education, SELD oversees curriculum development, teacher recruitment, and school infrastructure provisioning across Sindh. It administers provincial education budgets, distributes textbooks, and implements donor-funded programs (e.g., USAID literacy initiatives). Through SEMIS (Sindh Education Management Information System), the department monitors school performance metrics, teacher attendance, and enrolment trends.

Key Resources:

- Substantial teaching workforce across primary, secondary, and specialist educator tiers
- School leadership teams with trained administrators
- Network of public education facilities with dedicated girls' secondary institutions
- Technology-enabled systems for staff monitoring and resource distribution

Critical Limitations:

- Inadequate physical infrastructure in rural learning environments
- Persistent pedagogical gaps in instructional quality
- Systemic operational challenges in staff deployment protocols
- Uneven policy implementation across geographically isolated areas.

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2. District Education Office (DEO), Sukkur

The DEO serves as the implementation arm of SELD, conducting school inspections, managing teacher deployments, and coordinating with School Management Committees (SMCs). It compiles district-level education data for provincial reporting and oversees minor infrastructure repairs.

Operational Capacity:

- Staffing includes few education officers (male/female) and field supervisors.
- SEMIS-linked attendance dashboards, standardized inspection formats.

Institutional Constraints:

- Logistical gaps include only limited vehicles serving schools, hindering monitoring.
- Bureaucratic delays require SELD approval for expenditures
- Manual data aggregation results in reporting lags of 3-6 months.

3. Higher Education Department (HED), Sindh

HED governs tertiary education via few public colleges in Khairpur, offering intermediate and bachelor's programs affiliated with Shah Abdul Latif University. It manages faculty recruitment through SPSC and allocates development funds for lab upgrades.

Existing Capacity:

- Significant gender disparity favouring males
- Insufficient number of functional science labs.

Critical Barriers:

- High vacancy rate in STEM subjects.
- Infrastructure deficit involves libraries lack reference materials.

4. Sindh Education Foundation (SEF)

SEF bridges access gaps through public-private partnerships, operating non-formal schools in Khairpur's underserved villages. It provides performance-linked grants to NGOs, administers annual learning assessments (ASAT), and supplies free uniforms/stationery.

Resource Base:

- Partnerships with 12 local NGOs managing community schools.
- Funding through annual budget (60% donor-dependent).

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Systemic Challenges:

- Serves only a few out-of-school children in Khairpur.
- Teacher attrition rates are high due to low wages
- Absence of secondary options forces graduates to discontinue their education.

C. Health

The healthcare system in Khairpur operates through a network of provincial and district-level institutions, each playing distinct but interconnected roles in service delivery. Despite existing infrastructure, the sector faces challenges in accessibility, quality, and governance.

1. District Health Office (DHO), Khairpur

The District Health Office (DHO), Khairpur is the main government body responsible for managing and monitoring healthcare services across the district. It ensures the smooth operation of hospitals, rural health centres, and basic health units, providing essential medical services to the local population. The DHO oversees vaccination programs, maternal and child healthcare, disease control, and public health awareness campaigns. It also coordinates with provincial health authorities to implement health policies and improve service delivery. By managing staff, medical supplies, and emergency response efforts, the DHO plays a vital role in protecting and promoting the health and well-being of the people in Khairpur.

Resources Allocation:

- Salaried medical and paramedical staff (posted by Sindh Government)
- Operational budget from Health Department, Sindh
- Government ambulances and medical transport
- Access to vaccines and medicines for immunization and maternal-child programs
- District Health Information System (DHIS) for data tracking

Limitations and Challenges:

- Staff shortages in rural and remote BHUs
- Outdated infrastructure in some health facilities
- Dependency on provincial funds leads to delays in maintenance and supply
- Limited access to digital health tools in remote centres
- Weak enforcement of accountability in field staff

2. People's Primary Healthcare Initiative (PPHI)

PPHI manages many BHUs in Khairpur under a public-private model, focusing on maternal health, vaccinations, and outpatient care. It employs community health workers for outreach.

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Key Resources:

- Funding through annual budget (Sindh Government + World Bank).
- Android-based real-time monitoring of patient visits.

Critical Limitations:

- No emergency or surgical care, patients are referred to Sukkur.
- Excludes urban slums and katcha (riverine) communities

D. Recreation

The management of parks, green belts, and recreational areas in Khairpur involves coordinated efforts between provincial authorities and local administrative bodies. Each institution operates within defined legal mandates to address urban greening, public space maintenance, and encroachment prevention.

1. Khairpur Municipal Committee (MC Khairpur)

As the local administrative authority, the Municipal Committee (MC) Khairpur is responsible for delivering core urban services such as water supply, solid waste management, drainage maintenance, and the upkeep of municipal roads. Its statutory functions also include managing property tax records, issuing trade licenses, and registering vital statistics such as births and deaths. While the Committee does not have direct authority over housing development, it plays a critical supporting role by monitoring land use, enforcing building regulations in coordination with the Sindh Building Control Authority (SBCA) Khairpur Region, and providing ground-level data to provincial and district-level planning and development agencies. The capacity assessment of MC Khairpur is as follows:

Revenue Sources:

- Local property taxes and business license fees
- Provincial Finance Commission transfers

Human Resources:

- Limited technical staff for urban planning functions
- Manual administrative systems

Operational Deficiencies:

- Acute shortage of qualified town planning professionals.
- Inefficient revenue collection mechanisms.
- Antiquated record-keeping practices hindering service delivery.

E. Disaster Management

Disaster Risk Reduction (DRR) is a cross-cutting theme, requiring the active participation of all stakeholders. This approach is essential for establishing a well-coordinated mechanism to ensure effective preparedness and

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response in the face of disasters. Following are the roles and responsibilities of various institutional bodies including the District Disaster Management Authority (DDMA), Taluka Disaster Management Committees (TDMCs), and Union Council Disaster Management Committees (UCDMCs). These institutions are tasked with disaster mitigation and coordination, in alignment with directives from the National Disaster Management Authority (NDMA) and the Provincial Disaster Management Authority (PDMA), thereby ensuring coherence with both national strategies and local needs.

The roles, responsibilities, and functions of the authorities and committees outlined are derived from Chapter IV and V of the National Disaster Management Act, 2010, as well as the relevant provisions of the Sindh Local Government Act, 2013, which define the disaster management responsibilities of Union Councils.

1. Provincial Disaster Management Authority (PDMA)

Established in 2010 after promulgation of National Disaster Management Act, the Provincial Disaster Management Authority function under Rehabilitation Department, Government of Sindh. A dedicated authority for disaster management was established in purview of smooth inter and intradepartmental coordination, early preparedness for disaster mitigation, prevention, swift response to disasters and early recovery, and rehabilitation on build back better principals.

Following are the Provincial Disaster Management Authority composition representatives;

Table 2-3, Representatives of PDMA

Sr. No.	Representative	Role
1.	Minister Rehabilitation Department	Chairperson
2.	PDMA Board	Member
3.	Secretary Rehabilitation	Member
4.	Director General	Member
5.	PS to DG	Member
6.	Director F/A	Member
7.	Director Operations	Member
8.	Deputy Director F/A	Member
9.	Deputy Director Hyderabad/Sukkur	Member
10.	Deputy Director OPS	Member
11.	Deputy Director HQ & COORD	Member
12.	Deputy Director Sukkur	Member
13.	Assistant Director F/A	Member
14.	Assistant Director Civil	Member
15.	Assistant Director Procurement	Member

Sr. No.	Representative	Role
16.	Assistant Director Admin Finance	Member
17.	Assistant Director Hyderabad	Member
18.	Assistant Director (OPS-II)	Member
19.	Assistant Director (OPS-I)	Member
20.	Assistant Director Sukkur	Member
21.	Data Processing Assistant	Member

Source: *PDMA, Sindh*

Responsibility of Provincial Disaster Management Authority (PDMA) are as follows;

- Develops and implements strategies for early preparedness, risk reduction, and disaster mitigation across Sindh.
- Coordinates swift response during disasters and oversees early recovery and rehabilitation based on "Build Back Better" principles.
- Formulates and executes disaster management plans at the provincial level.
- Ensures inter- and intra-departmental coordination among government agencies for effective disaster management.
- Supervises and coordinates with 30 District Disaster Management Authorities (DDMAs), led by respective Deputy Commissioners, for grassroots-level implementation.
- Undertakes reforms, capacity building, equipment procurement, and infrastructure enhancement to strengthen provincial disaster management capabilities.
- Successfully managed large-scale disasters, including the 2010 and 2022 floods.

2. District Disaster Management Authority (DDMA)

The National Disaster Management Act (NDM Act), promulgated in Pakistan in 2010, provides the legal framework for disaster management across the country. Under Chapter IV, Section 18 of the Act, the establishment of District Disaster Management Authorities (DDMAs) in all districts is mandated including Khairpur.

According to the NDM Act, 2010, the DDMA functions as the primary coordinating body for disaster management within a district. It works in collaboration with government departments and non-governmental organizations to implement disaster management plans and actions.

Organizational Structure and Members of DDMA

The Deputy Commissioner of the district will be the chairperson of DDMA and Additional Deputy Commissioner shall be the District Disaster Management Officer (DDMO). Following is the list of members for DDMA committee;

Table 2-4, Committee Representatives of DDMA

Sr. No.	Committee Representative	Role
1	Deputy Commissioner	Chairperson
2	Additional Deputy Commissioner	DDMO
3	Senior Superintendent of Police	Member
4	Assistant Director Local Government	Member
5	District Information Officer	Member
6	Cantonment Officer (Where Applicable)	Member
7	District Health Officer	Member
8	District Education Officer	Member
9.	District Food Controller	Member
10.	Deputy Director Civil Defense	Member
11.	District Officer Social Welfare	Member
12.	District Officer Livestock	Member
13.	District Chairman Zakat	Member
14.	Executive Engineer (Works and Services)	Member
15.	Executive Engineer Irrigation	Member
16.	Executive Engineer Public Health	Member
17.	Municipal Commissioners / CMOs / TMOs	Member(s)
18.	Representative Officer of Armed Forces	Member
19.	Two Elected Representatives nominated by the chair	Members
20.	Two Representatives of NGOs/Civil Society	Members
21.	Two Representatives of Business Community	Members
22.	Representative of Agriculture and Livestock Department	Member
23.	Representative of NHA	Member
24.	Representative of Electric Supply Corporation	Member
25.	Representative of SSGC	Member
26.	Representative of Red Crescent	Member
27.	Representative of Sindh Scouts	Member
28.	Representation of Volunteers from Communities at Risk	Member(s)

Source: *PDMA, Sindh*

Following are the responsibilities and functions of DDMA;

- The DDMA shall work as a coordinating body of all government agencies and non-government organizations operating in the district and act as a focal authority in the conduction and implementation of plan and actions on disaster management.

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- Additional Deputy Commissioner who is proposed as Disaster Management Officer shall also work as Secretary DDMA and will provide administrative support to DDMA.
- The DDMA shall ensure to take all possible disaster management measures in the district in accordance with the guidelines laid down by PDMA or NDMA.
- The DDMA shall provide leadership by taking initiative to achieve MHVRA Informed Disaster M2anagement Plan goals and objectives.
- The DDMA shall coordinate with PDMA Sindh in disaster preparedness, response and recovery.
- The DDMA shall provide guidance and support for the implementation of district response plans including management of the District Emergency Operation Centre.

Functions of DDMA

- To review district disaster management plan, including district response plan in-line with Provincial and National disaster management plans and policies.
- To ensure that risk maps are developed and updated and disaster-prone areas have been identified and prioritized in the district.
- To coordinate the efforts for prevention and mitigation measures that are undertaken by the government and local authorities in the identified vulnerable areas of the district.
- To organize and coordinate specialized disaster management training programs for different.
- levels of officers, employees, and volunteer rescue workers in the district.
- To facilitate community training and awareness programs with the support of local authorities, government and non-government organizations.
- To set up, maintain, review and upgrade the mechanism for early warning and dissemination of accurate information to concerned authorities and the general public.
- To review development plans prepared by the government departments, statutory or local authorities with a view that disaster management plan has been integrated into the development activities and projects of the plan
- To coordinate with, and give guidelines to, local authorities in the district to ensure that pre-disaster and post-disaster management activities in the district are carried out promptly and effectively
- To prepare, review and update district level response and contingency plans.

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- To identify buildings and places which could, in the event of disaster situation be, used as relief centers and camps and make arrangements for water supply and sanitation in such buildings or places
- To distribute relief and facilitate rescue or ensure disaster preparedness and response
- To ensure operationalization of District Emergency Operation Centre (DEOC) equipped with all necessary gadgets
- To activate the District Emergency Operations Centre (DEOC) and ensure its uninterrupted operation during and after disaster events
- To carry out rapid damage and needs assessment and develop a report for assisting PDMA and other relevant stakeholders
- To coordinate and monitor early recovery and rehabilitation activities with the support of PDMA or relevant local and international stakeholders
- To prepare and continuously update databases of external agency projects, future priority areas, funding framework, available resources, areas of operations/expertise etc.
- To perform other functions as deemed necessary by the provincial government or provincial authority for disaster management in the district.

2.3.3 Geography

Municipal Committee Khairpur, a historic city, is the Taluka Headquarter of Khairpur taluka, with a population of 191,044 according to the 2023 census. It is situated at 27° 31'47" N and 68° 45'29" E, with an altitude of approx. 28 meters (92 feet) above sea level. Khairpur city is located 18 kilometres (11 miles) south of the Indus River along the National Highway (N-5), as well as at an approximate distance of 22 kilometres (13 miles) to the south of Sukkur via N-5. These roads serve to connect the settlements in various directions of Khairpur District with the surrounding important urban centres of the area. Additionally, railway station also exists in the city on the Mainline (ML-1) providing the access routes of the city.

2.3.4 Demographic Analysis

The study of the human population size, composition, spatial distribution, and variations over time have all been examined in demographic analysis. In the case of Khairpur city, these analyses depict the impact of the high monsoon rains, floods that began in 2010 and onward, and urbanization.

The population, age of residents, gender, and population density provide the type of information needed to plan for the residents' diverse needs. Future estimates for service and resource demands, including the number of facilities and sites for new facilities, etc., will be made with the help of these analyses.

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A. Past Population Trends

Khairpur city conducted the population census in 1951, 1961, 1972, 1981, 1998, 2017 and 2023. **Figure** 2-6 represents past population trend of Khairpur city and depicts a continuous rise in population with varied growth rate. In 1951, the population of Khairpur was 18,186, which increased by 88% in the next 10 years till 1961 this is due to the change in the administrative status of Khairpur which is declared as MC in 1959. From 1961 to 1972 there is a change in population of almost 41% is observed in the MC. From 1972 to 1981, there was only 27% increase in population has been observed this is due to the sub-division of the territorial boundaries and the decrease in growth rate. From 1981 to 1998, the highest growth rate in the history of Khairpur city was observed i.e., 3.24% causing an increase in population around 72%. From 1998 to 2017, 73% increase in population has been observed despite the fact that the growth rate decreased due to the 2010 flood, but the flood effected from nearby settlements migrated towards the Khairpur city. Two major cities of the district, Khairpur and Gambat cities were favourites owing to human basic facilities. But 18% of migrants were not shifted towards their own homes, the result was that the urbanization has been increased rigorously and housing societies were developed over the agricultural land[7].

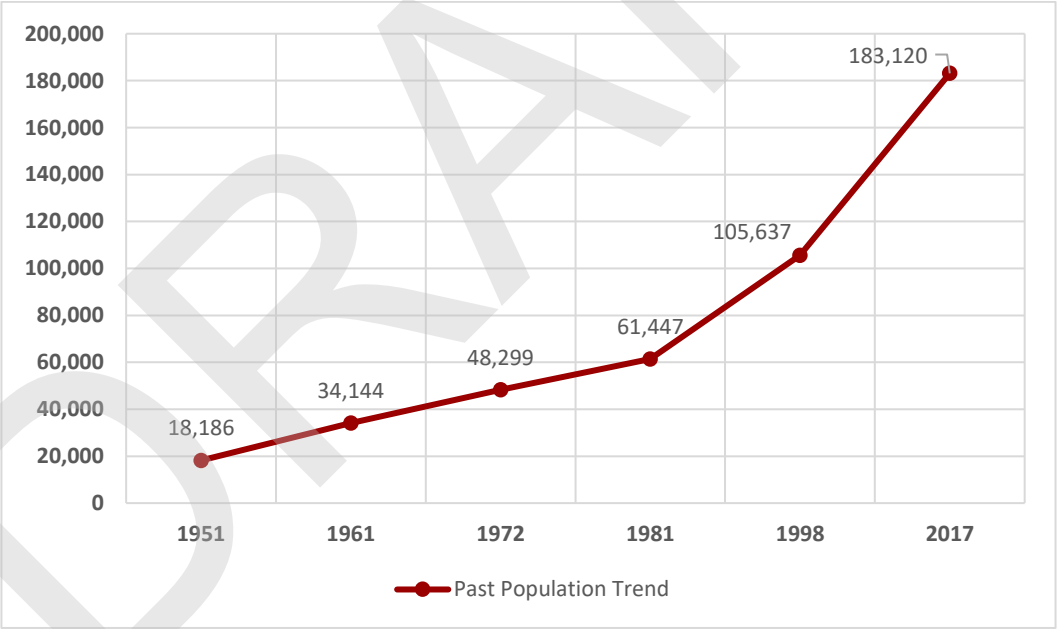


Figure 2-6, Intercensal Population Growth Trend of Khairpur City

Source: *Pakistan Bureau of Statistics*

The fluctuation in growth rate is shown in the **Figure** 2-7

[7] https://pssr.org.pk/issues/v6/2/implications-of-urbanization-on-agricultural-land-a-case-study-of-khairpur-district-pakistan.pdf

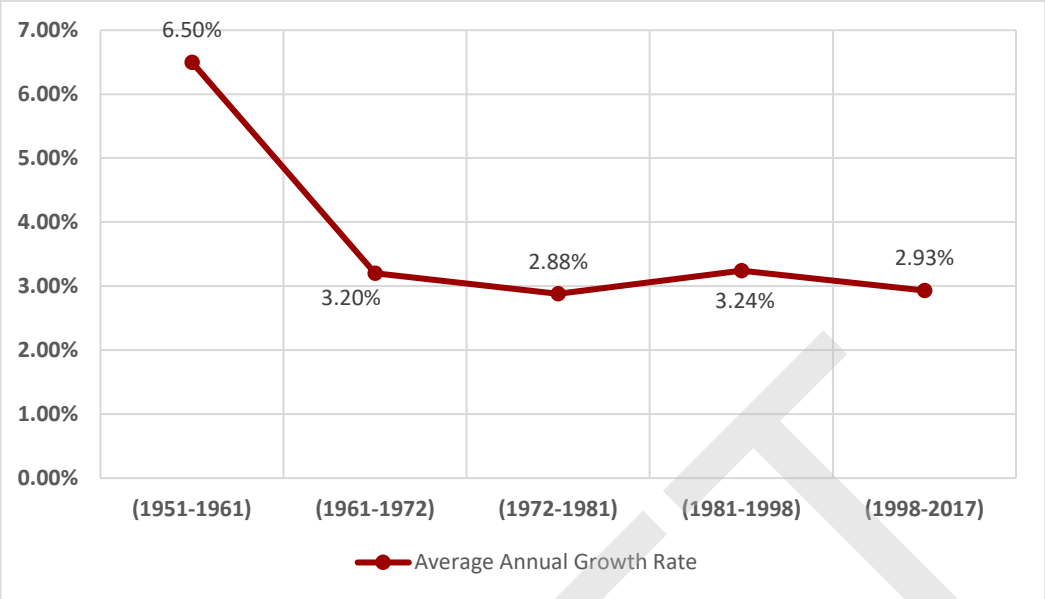


Figure 2-7, Intercensal Average Annual Growth Rate Trends of Khairpur City

Source: *Pakistan Bureau of Statistics*

The **Table** 2-5 represents the male and female population percentage by using the census data from 1961 to 2017. It can be evaluated from the table that initially in 1961 there was a difference of almost 14% in male and female population, male being the dominant factor of the city. This difference in sex population decreases with the passage of time to 4% in 2017 depicting that there is a need to plan equal facilities and opportunities for both males and females in the future.

Table 2-5, Intercensal Population Distribution by Gender of Khairpur City

Year	Male Population (%)	Female Population (%)
2017	52%	48%
1998	52%	48%
1981	53%	47%
1972	55%	45%
1961	57%	43%

Source: *Pakistan Bureau of Statistics*

B. Age Distribution

The age distribution trends are analysed from the data collected from 2017 census[8] and the socio-economic survey conducted in 2023. The population between the age of 10 years and above was 55% according to 2017 census which decreased to 49% in the base year according to socio-economic survey. Likewise, according to 2017 census and the socio-economic survey

[8] *2017 age-wise distribution data is utilized because the 2023 census data for age distribution in urban localities is not yet available.*

2023 the adult population (i.e., 18 years and above) varies from 41% to 50% respectively. And the dependent population (i.e., 60 years and above) decreased from 4% and 1% respectively. According to the socio-economic survey 2023 largest cohort of population is adult i.e., 18 years and above.

C. Population Projections

Population projection is a vital aspect of urban planning, helping cities anticipate future needs and plan resources accordingly. Previously, Khairpur has experienced significant population growth over the years. According to the 2023 census, the population of MC Khairpur is 191,044 with growth rate of 0.71%, covering an area of 30 sq.km. However, the growth rate of census 2023 may not be used for future growth projections due to the following reasons:

- Khairpur city's general topography presents a terrain that is particularly susceptible to urban flooding, which significantly heightened its vulnerability during the riverine floods of 2022, making the city more prone to severe damage and increasing the risk of mortality among its residents during the disaster
- The global decline in population growth rates is also a contributing factor to the decrease in the city's growth rate. As demographic trends shift on a worldwide scale, the city is similarly affected, leading to a reduction in its population growth.
- COVID-19 has also been a significant factor in the decline of the city's growth rate over the span of six years (2017-2023). The pandemic led to disruptions in economic activities, migration patterns, and overall population dynamics, contributing to the slowing down the growth rate observed during this period.
- Moreover, the observed fluctuations in the past intercensal growth rates, where the population growth rate was recorded at 2.93% in 2017 and significantly decreased until 2023, an average growth rate of 2.93% has been used as a pivotal value for the future growth scenario to ensure a balanced and sustainable projection.

For future planning, existing compact built up area with contiguous urban boundary is marked that also includes a proportion of an area outside of notified MC boundary and the current population inhabiting in these areas has also been considered in future population projections. This expansion has resulted in the total population of the city reaching 263,645 persons with growth rate of 2.93%, covering an area of 24.93 sq.km (2,493 ha), ultimately resulting in population of urban contiguous boundary being used for the population projections till 2043.

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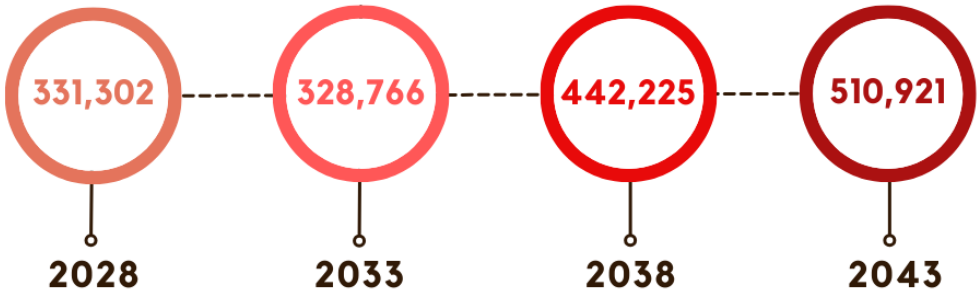


Figure 2-8, Population Projections of Khairpur City (2023 - 2043)

Source: *The Consultant Team*

Figure 2-8 shows the population projection of the city that has been calculated using the geometric growth model, providing a comprehensive understanding of future demographic changes. compares three growth scenarios.

D. Population Density

A dasymetric population density map has been developed for Khairpur city to provide a more precise representation of population distribution than traditional methods. Unlike standard choropleth maps that rely solely on administrative boundaries, this map uses additional data sources, such as land use, satellite imagery, and building footprint to focus on inhabited areas while excluding uninhabited spaces. Covering 2,493 hectares with a population of 263,645 in 2023, the city features 132 census blocks with densities ranging from 5 to 600 persons per hectare, averaging 107 persons per hectare. The National Reference Manual categorizes the population into low density (36%, 70-160 persons/ha) observed throughout the periphery and suburban zones, medium density (45%, 161-396 persons/ha) along main

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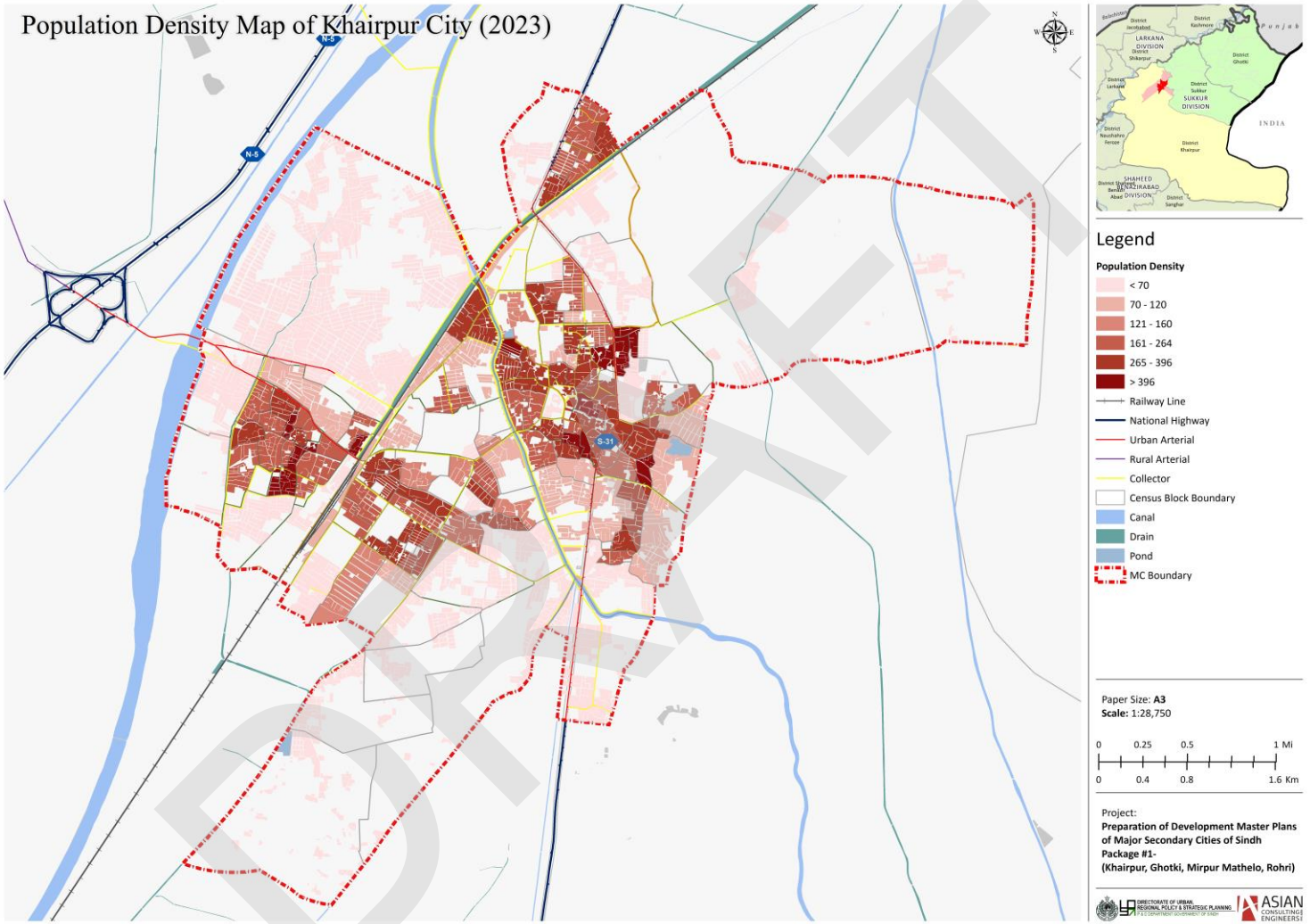


Figure 2-9, Population Density Map of Khairpur City

Source: *The Consultant Team*

roads, and high density (19%, above 396 persons/ha) is observed within the downtown area of city particularly along National Highway.

The dasymetric map (**Figure** 2-9) above shows population density based on census blocks, with darker colours indicating a higher population density.

2.4 Urban Morphology

Khairpur city's urban form is characterized by a compact development pattern, with a mix of high-density inner areas, medium-density outer-central areas, and low-density outskirts. The city features a predominantly mixed-use land configuration, where residential, commercial, and cultural spaces coexist within the same neighbourhoods, creating vibrant and dynamic urban environments. This density is accommodated through small plot sizes and multi-storey buildings, with 64% of the city having a density greater than 160 people per hectare. The city's urban form includes historically laid morphological forms such as dense, irregular street patterns, planned grid structures, and planned new towns. It also has a well-connected road network and access to rail transport, with both irregular and gridiron street patterns observed. New town development is noted along the Rohri Canal, contributing to the city's compact urban form.

The compact urban form of Khairpur offers several benefits, including increased productivity due to agglomeration economies, improved accessibility to urban services, and reduced travel times, resulting in a smaller ecological footprint. However, it also presents challenges such as traffic congestion, air pollution, loss of recreational spaces, and higher land values and housing costs, which can disproportionately affect renters, first-time buyers, and low-income households. To successfully harness the benefits of compact cities while avoiding negative impacts, comprehensive policy interventions are necessary. These interventions can include regulatory and fiscal tools to ensure sufficient housing supply and affordability, sustainable transport options, and the preservation of green and public spaces.

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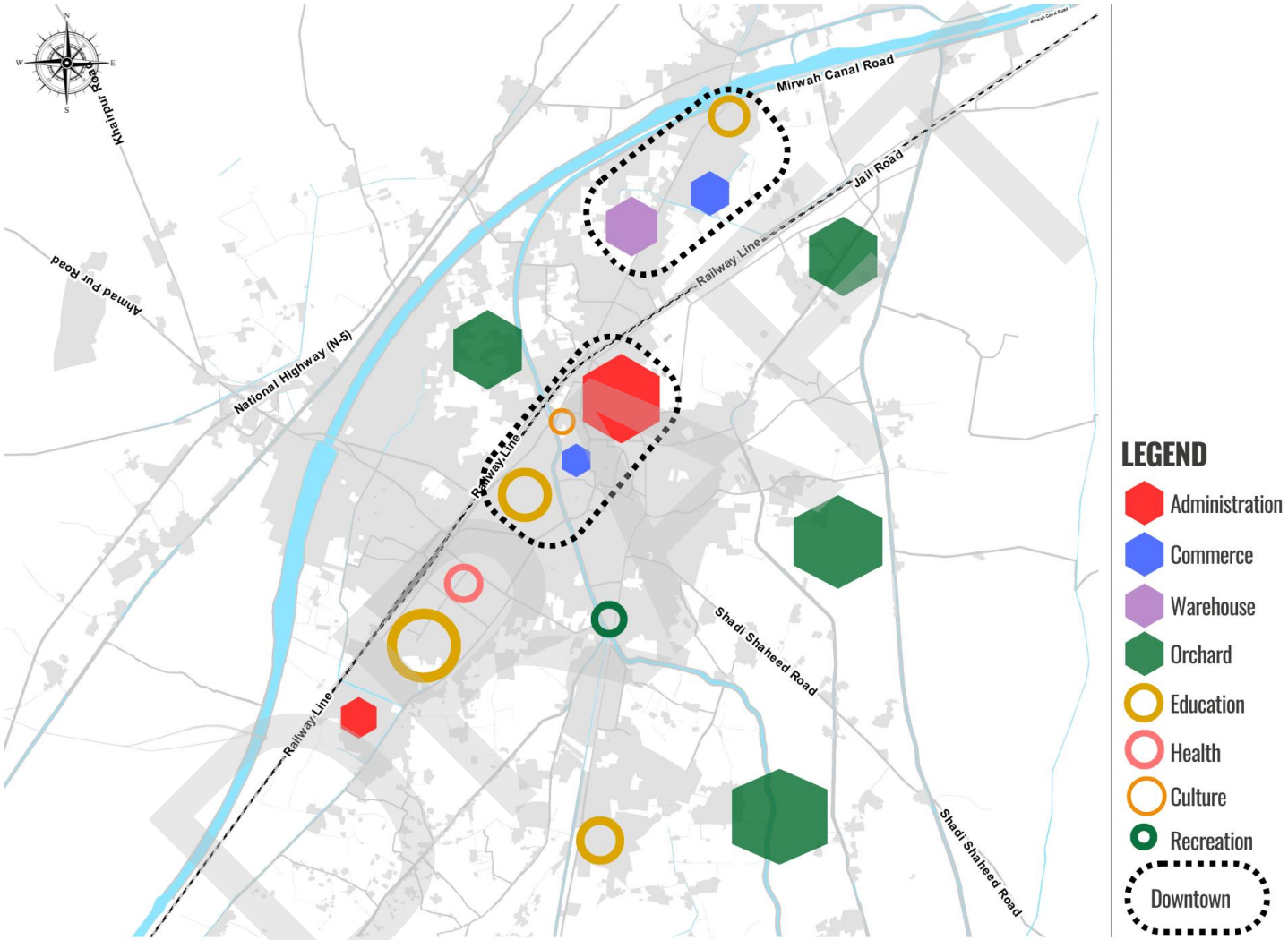


Figure 2-10, Existing Urban Form of Khairpur City (2023)

Source: *The Consultant Team*

2.5 Spatio-temporal Analysis

Spatio-temporal growth analysis for Khairpur city is assessed from the year 2008 to year 2023 at an interval of 5 years by using the satellite imagery. The resultant maps were classified to determine urban expansion over different time periods. The purpose of this analysis is to analyse the change in development pattern in context of population growth and rapid urbanization. The analysis depicts that the nearby cropland and farmland converted into a built-up area to meet the growing needs of people.

The analysis also shows that the extension of the city has taken place in all directions most predominantly in North-Western side of the city without proper planning and development control. The development after 2013 is mostly regular in shape as this period shows boom in the private housing schemes. New development is mostly bound within the Rohri canal and along Southern side of national highway passing through the city.

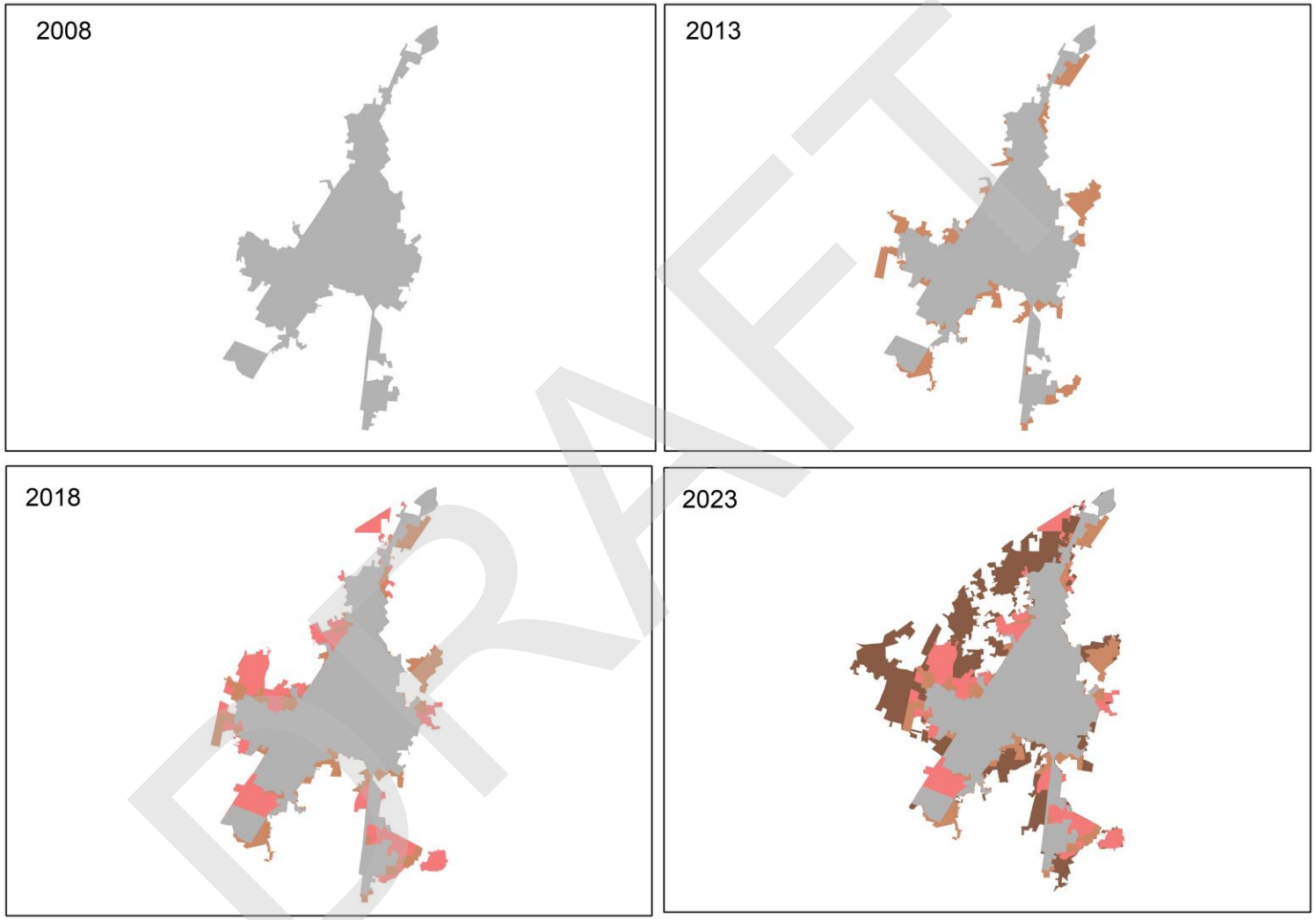
The total area of Khairpur city is 24.93 sq.km. among them, 12.2 sq.km. area is already developed in 2008 which is around 49.6% of the total city area and there is an increase of 16.4% is observed in developed area from 2008 to 2013. Huge increase in area is observed from 2018 to 2023 due to urbanization. **Table** 2-6 further shows the details of percentage increase in area which can be visualized in **Figure** 2-11.

Table 2-6, Spatio-temporal Growth Trends – Khairpur City (2008-2023)

Year	Area (sq.km)	Increase in area (sq.km)	Percentage Increase (%)
2008	12.2	-	-
2013	14.2	2.00	16.4
2018	18.1	3.9	27.5
2023	24.9	6.8	37.6

Source: *The Consultant Team*

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Figure 2-11, Spatio-Temporal Growth Map of Khairpur City (2008-2023)

Source: *The Consultant Team*

2.6 Existing Land Use (2023)

The land use analysis reveals that the city is expanding in the northern, and northwestern directions without proper planning along primary roads (such as National Highway (N-5), Khairpur Road, etc.). Approximately 90% of the designated built-up area of the city is utilized for urban land uses, which encompass residential, commercial, industrial, amenities, transportation, parks, playgrounds, and areas designated for residential schemes. The remaining area consists of non-urban land uses, including agriculture, orchards, major canals, and wasteland, primarily represented by large water ponds. The details are given in **Table** 2-7**.**

Table 2-7, Distribution of Major Land Uses in Khairpur (2023)

Urban/ Non-Urban	Land uses	Areas (Ha)	Percentage
Urban	Residential	1,240.85	49.76%
	Commercial	86.24	3.46%
	Parks and Playground	19.32	0.77%
	Institution	301.72	12.10%
	Utilities And Municipal Service Facilities	45.10	1.81%
	Religious	45.82	1.84%
	Industries	46.85	1.88%
	Special Use	114.88	4.61%
	Transportation	342.76	13.75%
	Sub Total	2,243.55	89.98%
Non-Urban	Agriculture and Forestry	180.00	7.22%
	Water Bodies	69.89	2.80%
	Sub Total	249.89	10.02%
Total		**2,493.44**	**100%**

Source: *The Consultant Team*

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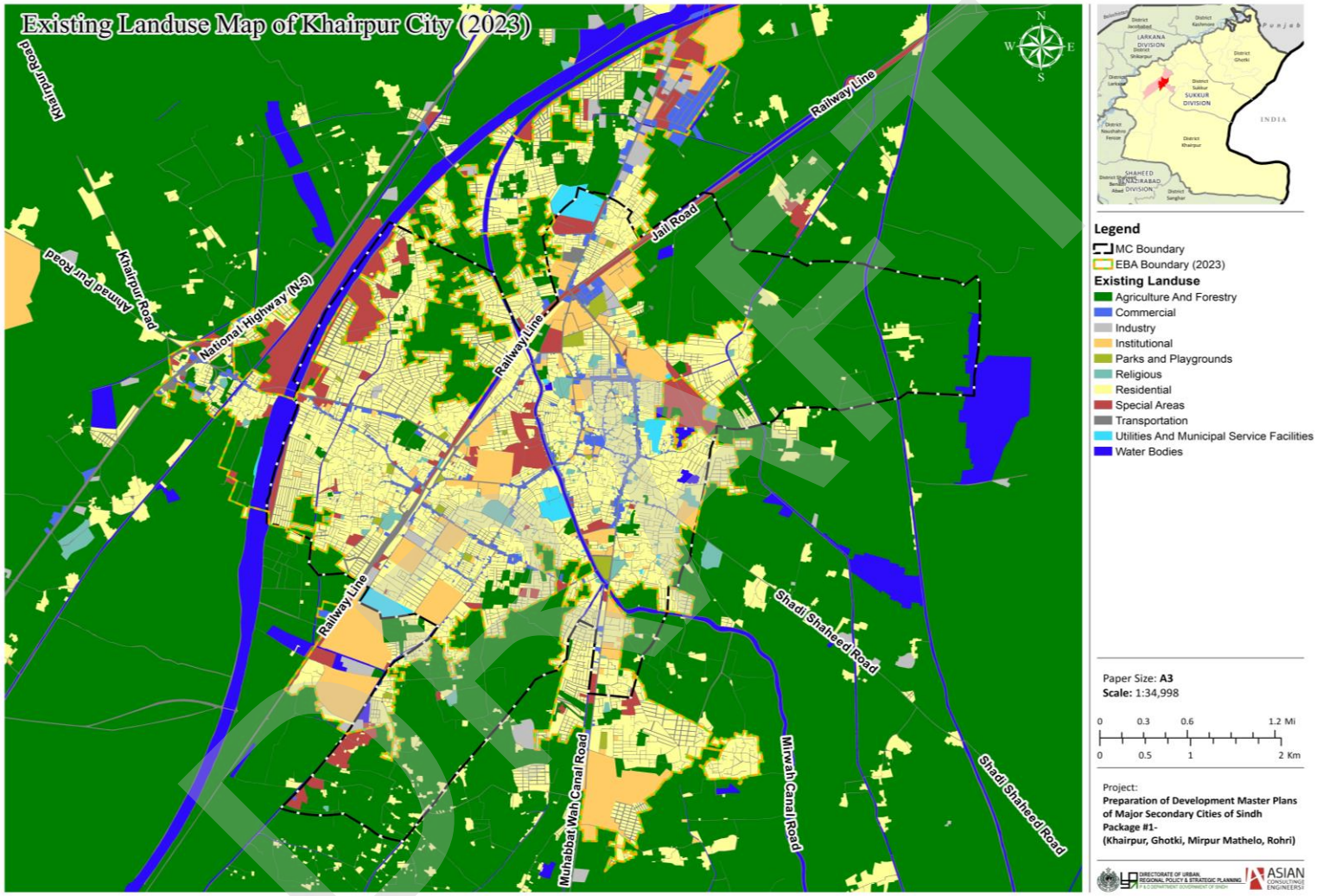


Figure 2-12, Existing Land Use Map of Khairpur City (2023)

Source: *The Consultant Team*

SECTION - 3: STRATEGIC DEVELOPMENT PLAN VISION

3.1 Introduction

This section presents the Strategic Development Plan Vision, outlining the long-term direction for sustainable, inclusive, and resilient growth. It explains how the vision aligns with community priorities, addresses key challenges, and guides future planning decisions. Serving as the foundation for the entire plan, this vision sets the course for balanced development, improved quality of life, and environmental stewardship.

3.2 Process of Vision Formulation

The vision formulation for Khairpur city is anchored in a participatory and structured approach aimed at aligning strategic development with the city's unique socio-economic, environmental, and cultural attributes. This visioning process will guide sustainable urban growth, resource allocation, and organizational decision-making over the coming years, with the ultimate goal of establishing Khairpur as a resilient, economically vibrant, and socially cohesive city.

The importance of vision development underscores the necessity for a forward-thinking framework that is responsive to Khairpur's current needs and adaptable to future demands. Through a holistic vision, the city aims to foster a healthy environment, stimulate economic development, and nurture strong community ties, ultimately enhancing quality of life. A vision development workshop was organized as a platform for stakeholders to collaborate and redefine priorities, address sectoral issues, and explore development opportunities.

Adopting the Oregon Model for Vision Development, the process engaged participants in a structured methodology across four fundamental stages:

City Profile: Profiling Khairpur's demographics, infrastructure, and environmental assets, capturing both strengths and areas of improvement.

Trend Statement: Projecting future scenarios based on ongoing trends, identifying possible outcomes, and considering alternative development trajectories.

Vision Statement: Articulating a shared vision for Khairpur's future, including goals in public health, education, cultural preservation, transportation, and economic growth.

Action Plan: Outlining actionable steps and partnerships to translate the vision into measurable progress, aligning policies and projects with the city's long-term aspirations.

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Figure 3-1, Oregon Model for Vision Development

Source: *Extracted by Consultant from Ames, 2010*

3.3 Vision Development Workshop

Workshop proceedings provided participants the opportunity to contribute in-depth insights about Khairpur's current situation and prospective development. Organized into sessions, the workshop tackled key questions: identifying overlooked issues, defining what makes a city great, and mapping the desired future of Khairpur. Stakeholders highlighted concerns around limited departmental capacity, transparency, and infrastructure strain due to migration. They emphasized the need for parks, healthcare improvements, public transport facilities, water treatment facilities, and solutions for waste management and flood-prone areas.



Figure 3-2, Pictorial Evidence from Future Vision Development Workshop

Source: *The Consultant Team*

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3.4 Khairpur's Vision Statement

Stakeholders' inputs and focus group discussions were followed by the vision development exercise in line with the key findings and issues identified by the participants. During this exercise, consultants assisted the participants, first, in brainstorming the future goals and targets as keywords, and then preparing a vision statement for Khairpur using those keywords. By analysing the outcomes of the proceeding following vision statement is derived:

> ***"Safe and Smart Khairpur: Fostering sustainable and inclusive development through balanced agro-based industry and vibrant environment."***

3.4.1 Strategic Goals and Objectives

The vision statement articulates strategic goals and objectives to guide Khairpur's sustainable long-term development, focusing on:

A. Sustainable and Inclusive Development

Goal: Ensure Khairpur meets residents' needs locally, reducing dependency on Sukkur/Hyderabad.

Objectives:

- Establish tertiary healthcare facilities, vocational training institutes, and higher education campuses.
- Launch microfinance schemes for women/youth-led enterprises and cooperatives.
- Integrate flood-resistant urban planning (e.g., elevated roads, green buffers along the Indus).

B. Balanced Agro-Based Industrial Growth

Goal: Become a regional hub for value-added agro-production and employment.

Objectives:

- Develop clusters for dates, rice, and sugarcane processing with modern storage/logistics.
- Partner with agriculture universities to train farmers in precision farming and export standards.
- Upgrade rural roads and digital platforms (e-commerce) to connect farmers to national/global markets.

C. Vibrant and Environmentally Conscious Communities

Goal: Enhance liveability through green spaces, efficient infrastructure, and safety.

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Objectives:

- Efficient Infrastructure
  - Introduce electric bus routes and bicycle lanes to connect key nodes (markets, schools, hospitals).
  - Solar-powered water filtration plants and smart metering for energy efficiency.
- Safety and Accessibility
  - Install LED streetlights and emergency response systems in high-risk areas.
  - Ensure 100% wheelchair accessibility in public buildings by 2035.
- Eco-Friendly Initiatives
  - Urban forestry projects (increase green cover by 25%) and waste-to-energy plants.

By integrating smart growth, sustainable and inclusive development, and innovative practices, the vision aims to create a sustainable future for Khairpur. This involves preserving natural resources, reducing environmental impact, and meeting present needs without compromising the ability of future generations to meet their own needs.

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SECTION - 4: PROPOSED STRATEGIC DEVELOPMENT PLAN - 2043

4.1 Introduction

This section presents the proposed Strategic Development Master Plan 2043 for Khairpur city, outlining the comprehensive planning process undertaken to guide future growth and development. It explains the formulation of planning scenarios based on existing conditions, projected needs, and sustainable development goals. The section also details the proposed land use zones and designed to optimize urban functions.

4.2 Planning Process

The development master planning process is required to guide the orderly growth and sustainable development of urban areas, ensuring that all aspects of land use, infrastructure, and environmental considerations are taken into account. This process involves multiple stages, including assessment, analysis, design, and implementation, to create a well-balanced and efficient plan. The **Figure** 4-1 illustrates the comprehensive planning process that is followed to achieve objectives of development master plan.

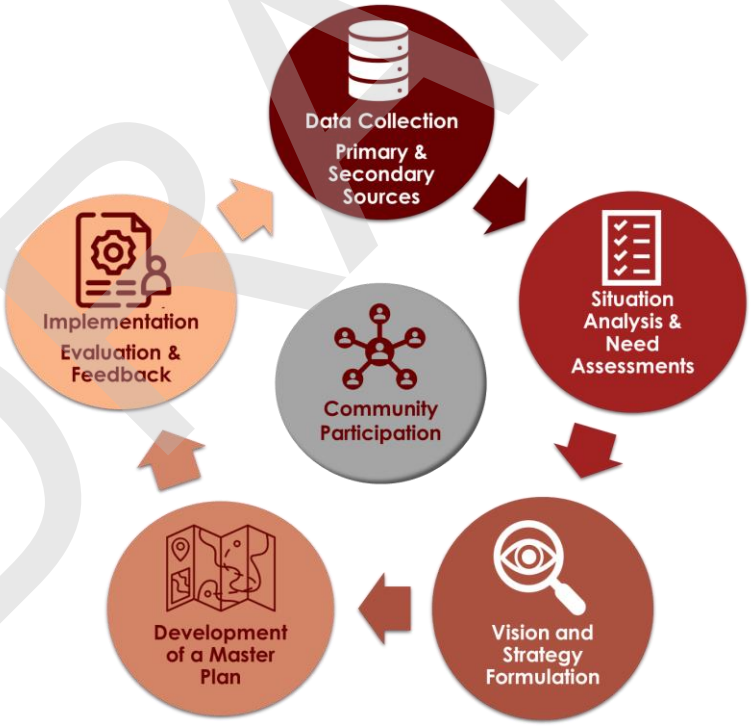


Figure 4-1, Planning Process of Strategic Development Plan

Source: *The Consultant Team*

4.3 Determinants for Planning Proposal

The main determinants of land use zoning ensure balanced and well-informed land use decisions. This inclusive approach helps in creating

sustainable and liveable environments. The main determinants which are considered while proposing the different land use zones in city are Physical/Geopolitical Barriers, Natural Barriers, Flood-Prone Zones (Hydrological Analysis), Existing Land Use/Infrastructure, Land Suitability Analysis, Growth Trend Analysis and Air and Wind Direction.



Figure 4-2, Key Determinants for Land use Zoning

Source: *The Consultant Team*

4.3.1 Physical/ Natural Barrier

Khairpur city faces significant physical and natural barriers that shape its urban expansion patterns. To the west, the National Highway (N-5) and the Rohri Canal act as major constraints, restricting development due to the presence of fertile orchards that are vital to the region's agriculture. On the eastern side, the Mirwah Canal poses another challenge, limiting urban sprawl by reducing the availability of cultivable land and constraining feasible development. Consequently, the city's growth potential is primarily channelled along the eastern and western corridors, closely aligned with the National Highway (N-5), which serves as a key infrastructural backbone for connectivity and expansion.

4.3.2 Land Suitability Analysis

Land Suitability Analysis (LSA) is a systematic process that helps to identify appropriate areas for various land uses, including residential, commercial, industrial or agricultural developments. By integrating Geographic

Information Systems (GIS) with multi-criteria decision-making (MCDM) techniques, LSA assesses land based on environmental, socio-economic, and infrastructural factors. This method ensures that land-use decisions are well-informed, sustainable, and aligned with both developmental needs and ecological preservation.

The LSA process begins with comprehensive data collection, which includes topographical details such as slope and elevation, soil characteristics like type and fertility, climatic conditions including rainfall and flood susceptibility, and existing land use patterns. Additionally, proximity to infrastructure such as roads and utilities, as well as socio-economic factors like population density and economic activities, are considered. This diverse dataset provides a holistic understanding of the physical and human factors influencing land suitability.

Once the necessary data is gathered, the next step involves defining and weighting the criteria that determine land suitability. Each criterion is assigned a weight based on its relative importance, often determined through expert judgment or structured methods like the Analytical Hierarchy Process (AHP). This weighting ensures that critical factors have a greater influence on the final suitability assessment.

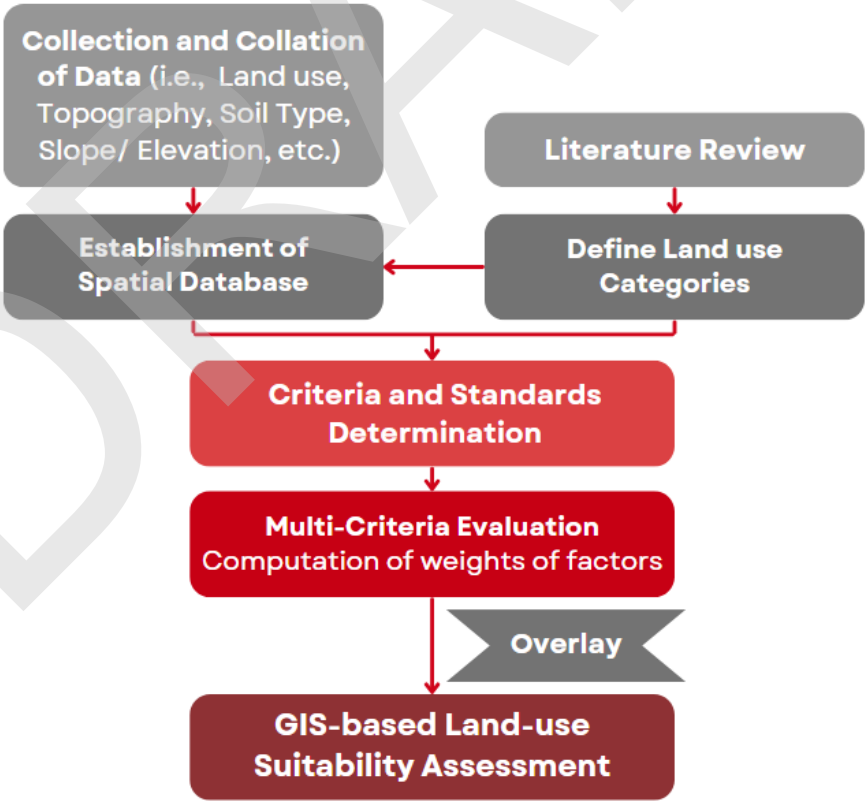


Figure 4-3, Flow Diagram of Land Suitability Analysis (LSA) Process

Source: *The Consultant Team*

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GIS plays a pivotal role in processing and analysing the collected data. Techniques such as overlay analysis, weighted overlay analysis, and buffer analysis are employed to integrate multiple layers of information and evaluate spatial relationships. Overlay analysis combines different maps to identify areas that meet specific conditions, while weighted overlay analysis aggregates the weighted criteria to produce a composite suitability score. Buffer analysis helps assess proximity-based factors, such as distance from roads or flood-prone zones.

The results of the analysis are classified into five suitability categories: most suitable, moderately suitable, less suitable, least suitable, and suitable but avoided. The most suitable areas exhibit optimal conditions with minimal constraints, making them ideal for the proposed land use. Moderately suitable zones may require minor adjustments or infrastructure improvements, while less suitable areas present significant challenges that need mitigation. Least suitable regions are marked by major limitations such as high flood risk or poor soil quality, rendering them unfavourable for development. Areas classified as suitable but avoided are typically protected or restricted due to ecological or regulatory reasons.

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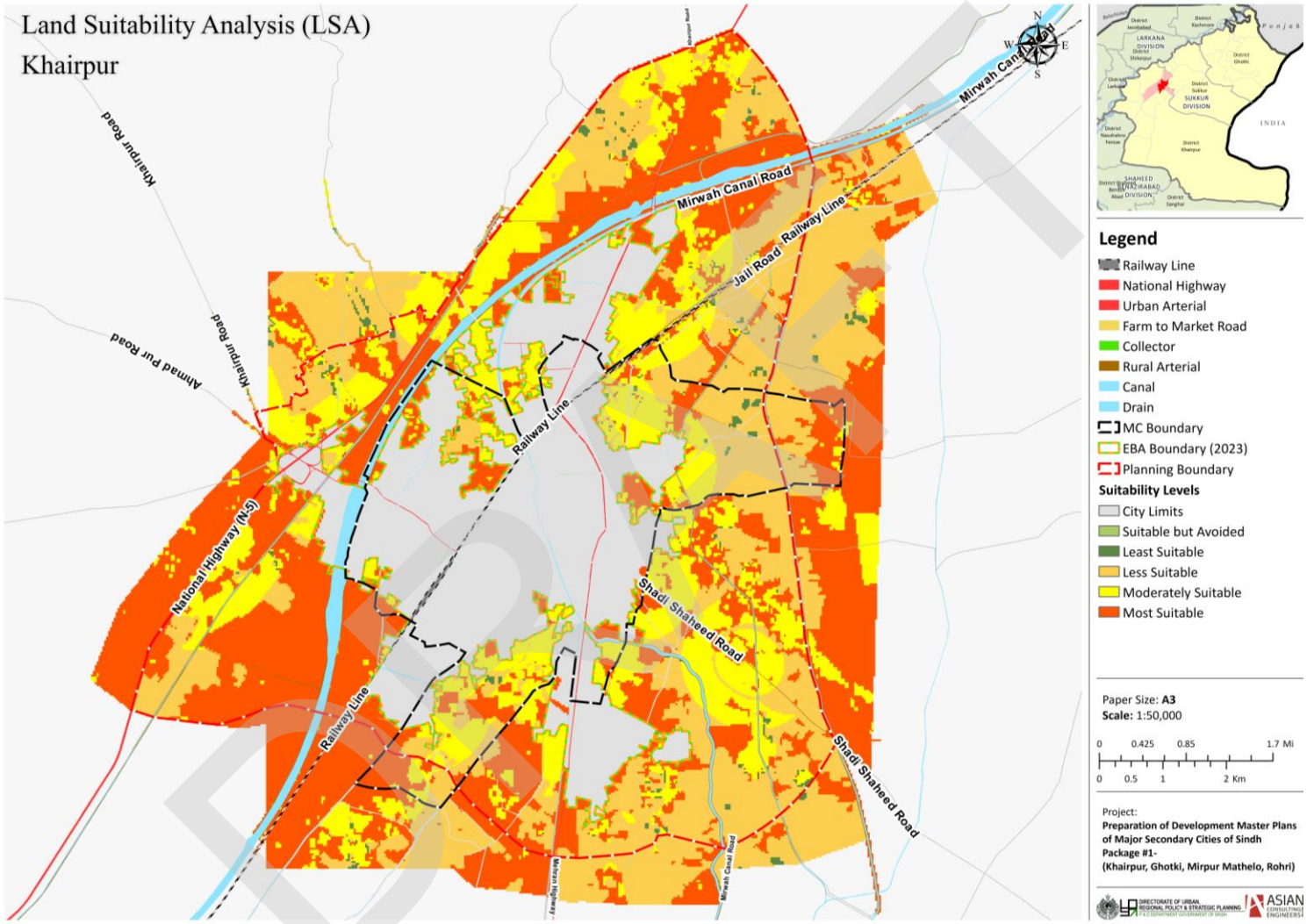


Figure 4-4, Land Suitability Analysis (LSA) - Khairpur

Source: *The Consultant Team*

The Land Suitability Analysis (LSA) map (**Figure** 4-4) of Khairpur city highlights variations in land suitability for urban development based on existing land use trends and infrastructural factors. The most suitable areas, marked as red, primarily concentrated in the south and north western parts of the city, align with existing urban development and key transportation corridors like National Highway (N-5) and Railway Line, making them ideal for expansion. Moderately suitable and less suitable zones extend outward from the urban core, indicating areas that may require interventions such as infrastructure improvements or flood protection measures.

4.3.3 Flood Prone Zone (Hydrological Analysis)

The hydrological analysis serves to evaluate flood impacts and guide disaster management efforts by identifying areas most affected by inundation and disrupted connectivity. This information is crucial for planning relief and rehabilitation measures. Additionally, it supports long-term urban and regional planning by identifying flood-prone zones that require mitigation strategies, contributing to the development of resilient land use and infrastructure plans.

The analysis was conducted using advanced 2D hydrodynamic modelling in HEC-RAS to accurately assess flood risks and impacts. The methodology incorporated high-resolution terrain data, with a 30-meter Digital Elevation Model (DEM) processed to capture subtle elevation changes critical for flood modelling. The study area was precisely defined using administrative boundaries of District Khairpur, ensuring the analysis aligned with jurisdictional planning needs. The model setup included creating a detailed 2D flow area with variable cell sizing, employing finer resolution in vulnerable urban centres and coarser grids in less critical areas to optimize computational efficiency.

The key hydraulic inputs included boundary conditions representing inflow/outflow points and gridded meteorological data, particularly for the August 2022 flood event that severely impacted the region. The model underwent rigorous calibration and validation against historical flood records and field observations where available. The simulation outputs provided comprehensive flood characteristics including extent, depth variations (from 0.05 foot to over 1 foot), flow velocities, and duration of inundation. These results (as shown in **Figure** 4-5) were visualized through detailed flood maps, with inundated areas clearly marked in blue gradients indicating depth variations, while critical infrastructure networks were overlaid to assess disruption impacts.

The analysis serves dual purposes for both immediate disaster response and long-term resilience planning. The detailed flood maps enable to identify priority areas for relief operations and evacuation planning. For long-term development, the results inform land-use zoning decisions, infrastructure design standards, and mitigation strategies, particularly for protecting vital

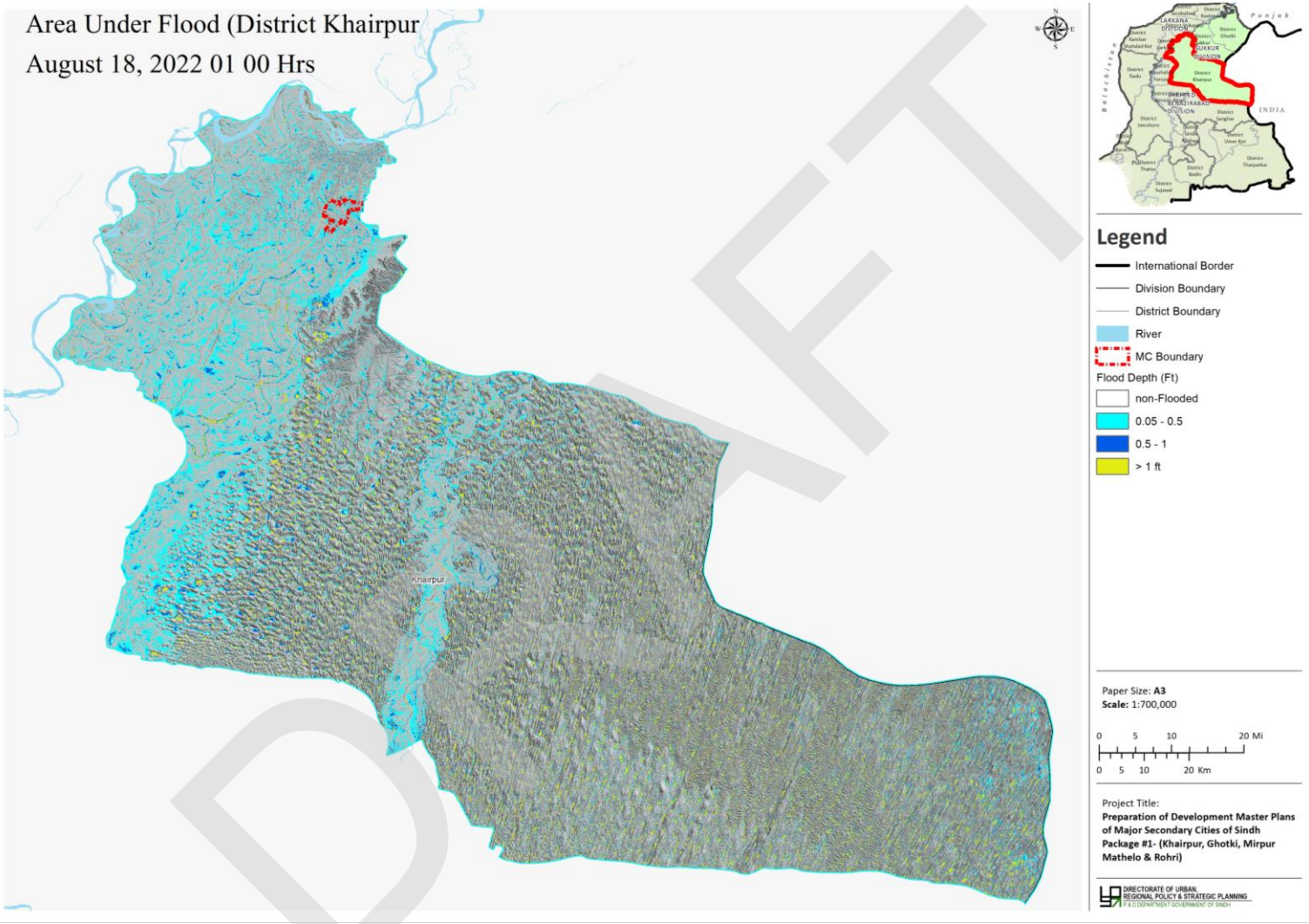


Figure 4-5, Hydrological Analysis – Khairpur District

***Source**: The Consultant Team*

transportation routes like motorways and primary roads. By incorporating administrative boundaries, the analysis provides actionable insights tailored for both urban and rural planning contexts, supporting the development of comprehensive flood resilience strategies across District Khairpur.

4.3.4 Existing Land use/ Land Cover

The analysis of existing land use/ land cover is crucial for Khairpur's sustainable urban development, as it provides a comprehensive assessment of how land is currently utilized, whether for residential, commercial, agricultural, industrial, or ecological purposes, while identifying inefficiencies, incompatible land uses, encroachment on roads, fertile agricultural land or flood-prone areas, and underused spaces that require intervention.

By evaluating the distribution of infrastructure, services, and natural resources, this analysis ensures future planning aligns with the city' s current skeleton, preventing haphazard expansion, environmental degradation, and resource mismanagement. The integration of land use/ land cover analysis into Khairpur's development plan will optimize land use, enhance resilience, and support coordinated development, ensuring the city's expansion is both economically viable and environmentally sustainable while improving quality of life for its residents.

4.3.5 Growth Trend Analysis

The spatio-temporal growth analysis of Khairpur city (2008 – 2023) provides vital insights for proposed zoning. It highlights urban expansion driven by population growth, with suburban areas transitioning into built-up zones along major roads. Key developments include new housing schemes along the southeastern side of Rohri Canal and mixed-use developments on National Highway (N-5). However, residential growth has occurred without adequate planning, leading to the destruction of dense orchards and presenting challenges for sustainable urban development These findings enable to allocate land use effectively, optimize infrastructure, and ensure sustainable urban development.

4.3.6 Air and Wind Direction

The wind rose for Khairpur city indicates that wind predominantly blows from the south to northeast. Understanding these airflow and wind patterns is essential for proposed zoning as it guides the optimal placement of industrial, commercial, and residential areas. Proper alignment reduces pollution exposure in sensitive zones, enhances ventilation, and promotes urban comfort, contributing to improved environmental quality and public health.

4.4 Planning Scenarios

To address city's urban growth and sustainable land use, three alternative development scenarios have been formulated:

- Multi-Nuclei Model
- Corridor Development Model
- Living Land Conservation Model

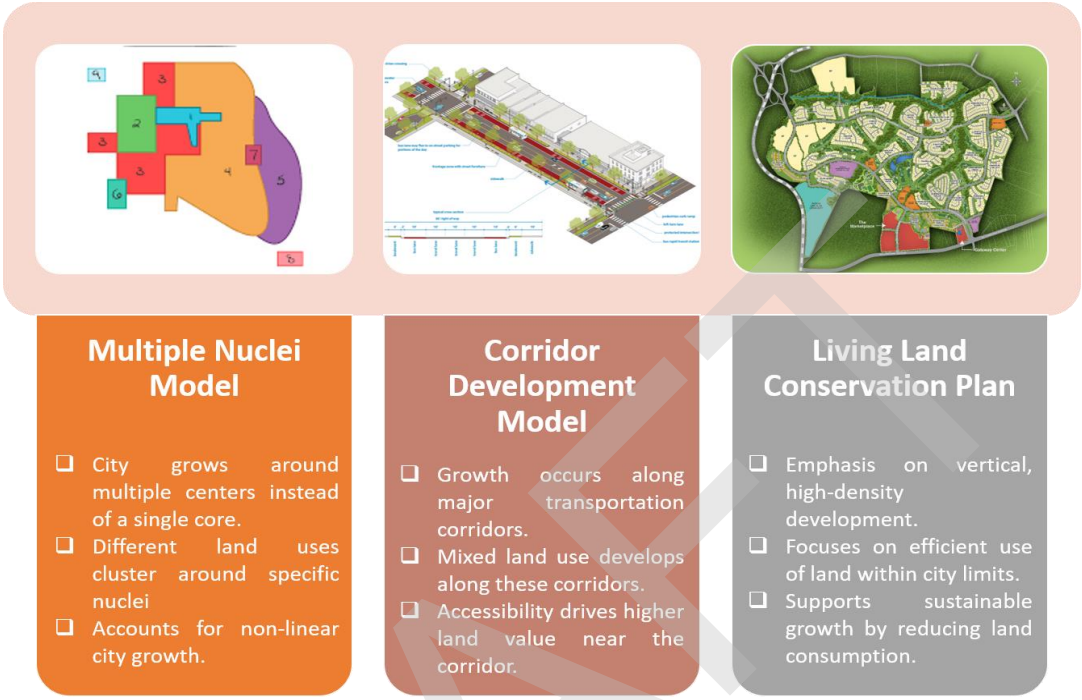


Figure 4-6, Proposed Development Scenarios for Khairpur City

Source: *The Consultant Team*

4.4.1 Multi Nuclei Model (Scenario 1)

The model advocates for decentralized urban development, distributing growth across multiple activity centres rather than concentrating it in a single core. This approach mitigates congestion in central areas while fostering specialized hubs that cater to diverse economic, social, and infrastructural needs. By allowing cities to expand organically through interconnected nuclei, the model supports balanced development and reduces dependency on a monolithic city centre. **Table** 4-1 shows the primary advantages and disadvantages of multi nuclei model.

Table 4-1, Pros and Cons of Multi Nuclei Model

Pros	Cons
• City can grow naturally with the development of new nuclei in response to the city's expansion, preventing overcrowding in a single city centre. • Encourages a mix of land uses, fostering community interaction and reducing the need for long-	• Requires robust and extensive road/ transport network or infrastructure to connect these nuclei effectively. • Some nodes may develop rapidly while others stagnate, creating disparities in land value and quality of life across different

Pros	Cons
distance travel. • The model allows for a more organic growth pattern, enabling different areas to develop according to their unique characteristics and needs. • Different CBDs can cater to various economic activities, promoting local businesses and creating job opportunities across different sectors.	parts of the city. • The establishment of multiple CBDs may lead to urban sprawl, consuming more land and potentially impacting agricultural or green spaces. • Managing and coordinating development across multiple centres can be more complex and require more sophisticated urban planning and governance.

Source: *The Consultant Team*

4.4.2 Corridor Development Model (Scenario 2)

The Corridor Development Model strategically directs high-density, mixed-use development along major transportation routes (e.g., highways, arterial roads, transit lines) to create vibrant, walkable urban spines. Unlike sprawl-based expansion, this model promotes compact, efficient land use by concentrating housing, offices, retail, and public services along key mobility corridors. **Table** 4-2 shows the primary advantages and disadvantages of this model.

Table 4-2, Pros and Cons of Corridor Development Model

Pros	Cons
• By focusing development along transport corridors (e.g., highways, railways), the city can improve accessibility and reduce travel time between important areas, benefiting daily commuters and facilitating efficient movement of goods. • Corridors can encourage high-density, mixed-use development around transit stations, reducing reliance on cars and promoting walkable, sustainable neighbourhoods that are more environmentally friendly. • Rather than spreading resources thinly, government can concentrate infrastructure investments (like roads, utilities, and transit) along these corridors,	• If not implemented carefully, corridor development may encourage urban sprawl, leading to longer commute times, higher vehicle emissions, and the loss of green spaces or agricultural land around the city. • Large-scale corridor development can harm the environment, particularly when natural habitats, water resources, or farmland are disrupted by new infrastructure and increased human activity. • Rapid corridor development can cause congestion on major routes, especially if public transit options are inadequate. Additionally, infrastructure upgrades may be necessary to

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Pros	Cons
leading to better quality services and reduced costs.	meet rising demand, straining municipal budgets and triggering sudden land price increases that reduce affordability.

Source: *The Consultant Team*

4.4.3 Living Land Conservation Model (Scenario 3)

This model promotes sustainable approach of urban development by strategically preserving agricultural and natural landscapes while accommodating controlled growth. Unlike conventional approaches that encourage unchecked sprawl, it prioritizes infill development while protecting vital farmland, forests, and watersheds. By balancing urban expansion with ecological conservation, the model offers a blueprint for sustainable growth, that maintains productive landscapes, strengthens local food systems, and enhances quality of life for both urban and rural communities. **Table** 4-3 shows the primary advantages and disadvantages of this model.

Table 4-3, Pros and Cons of Living Land Conservation Model

Pros	Cons
• This model conserves valuable agricultural and natural landscapes around city, protecting biodiversity and supporting local food systems. • Reduces the need for extensive new infrastructure, making it easier and more cost-effective to maintain and upgrade existing services and facilities • Higher density urban areas can decrease dependency on vehicles, resulting in lower emissions and energy use.	• Building vertically or converting existing low-density areas into high-density housing requires substantial planning and investment. • A significant increase in density can lead to overcrowding if not carefully managed, potentially causing issues like higher noise levels, limited green space, and increased strain on infrastructure.

Source: *The Consultant Team*

Following consultations with the client and stakeholders, and in consideration of Khairpur city's existing development structure, the Living Land Conservation Model (Scenario 3) has been selected for the proposed land-use zoning. This model supports sustainable urban growth by prioritizing high-density development and discouraging horizontal expansion. Through compact urban forms, it minimizes the conversion of agricultural land/ orchards for urbanization, preserving critical natural and agricultural landscapes. By integrating eco-friendly practices, the Living Land Conservation Model ensures a balanced development strategy that safeguards the city's green and productive resources for future generations.

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4.5 Conceptual Zoning Model

The conceptual zoning model for Khairpur city uses concentric planning circles to establish an organized yet flexible approach to urban expansion. **Figure** 4-7 illustrate that the inner circle is marked as Established Built-up Area, the darker outer zones represent high-potential areas for development, and the radial segments within the circles allocate specific land uses to meet the city's diverse needs. This design not only accommodates growth but also promotes environmental sustainability, efficient land utilization, and enhanced urban connectivity, offering Khairpur city a comprehensive framework for balanced and orderly development.

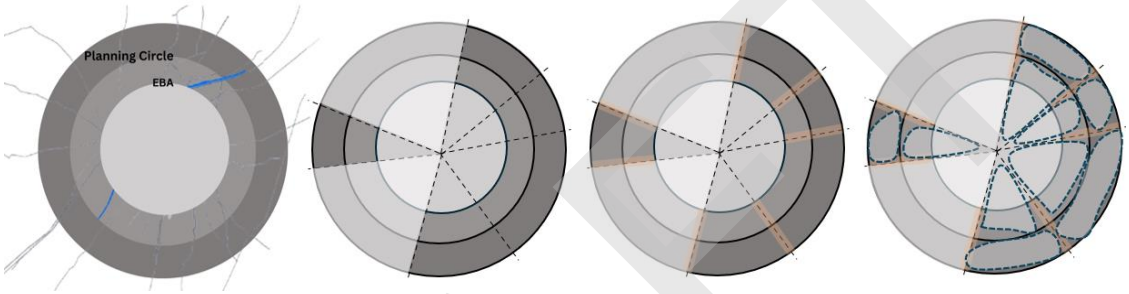


Figure 4-7, Conceptual Diagram for Planning Scenario - Khairpur

Source: *The Consultant Team*

4.6 Land Demand Calculation

To determine the future land demand for Khairpur city, a comprehensive assessment was conducted by considering the two main factors influencing land requirements: population and density. The density of Khairpur city has been increased by 50% in accordance with maximum achievable density to optimize land use. The population, which is the key driver of land demand, is derived from three primary sources:

- Existing urban population residing within the developed areas of Khairpur, who will require additional land over time to accommodate population growth and expanded urban services.
- Rural population within the designated urban expansion zone, which is expected to be integrated into the city's urban framework due to urban sprawl and natural engulfment, thereby necessitating additional urban land.
- Taluka rural population outside the planning boundary, of which 60% is considered for inclusion in the land demand calculations. This inclusion is justified as this portion of the population is expected to rely on Khairpur for higher-order urban facilities, while the remaining 40% will continue to fulfil their residential needs within their existing rural settlements.

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The calculation begins with the Current Population **(CP)** and the Current Area **(CA)** of Established Built-up Area[9] 2023, which gives the Current Population Density **(CPd)** by dividing **CP** by **CA**. To accommodate future growth, the Projected Population **(PP)** is determined based on demographic projections.

Current Population = **CP**

Current Population Density = **CPd**

A Desired Density **(DD)** is established[10] by increasing the Current Density by 50%, calculated as follows

Desired Density (50% increase) = DD = CPd + (CPd x 0.2)

Using this Desired Density, the Total Projected Area **(PA)** required for the projected population is calculated:

Total Projected Area = **PA = PP/DD**

New Area required = **PA – CA**

Table 4-4, Land Demand Calculation for Khairpur City (2023 – 2043)

Elements	Established Built-up Area (2023)	Rural Settlements inside UGB	Rural Settlements outside UGB
Population (2023)	191,044	7,297	210,695
Growth Rate (2023)	2.93	0.74	0.74
Estimated Population (2023)	286,757	-	-
Existing Area 2023 (ha)	2,493	63	-
Existing Density 2023 (pph)	116	-	-
Projected Population (2043)	510,921	8,457	244,170
Proposed Density (2023-2043)	175	175	175
60% of Projected Population	-	-	146,502
Cumulative Population 2023-2043	665,879		
Total Population with 5% Contingency	33,294		
Total Population 2023-2043	699,173		
Cumulative Area 2023-2043 (ha)	4,002		
Additional Area 2023-2043 (ha)	1,446		

Source: *The Consultant Team*

[9] The "Established Built-up Area" is defined as an "Urban Contiguous Area" refers to a continuous, connected zone of a city that is fully developed with infrastructure, buildings, and urban services.

[10] A comparison conducted for medium-sized cities shows that the maximum achievable density is only 15-20% higher than the current density. Additionally, population growth within the same area results in an overall increase in density.

4.7 Proposed Land Use Zoning

The proposed land use zoning plan provides a strategic framework for the long-term development of Khairpur city, incorporating prevailing planning standards and guidelines. This comprehensive plan carefully integrates the unique contextual features of the city, including its topography, distinctive landscape, and historical elements, recognizing their direct influence on urban planning decisions. By addressing these critical factors, the zoning plan establishes a framework for balanced growth over the next 20 years.

The plan's fundamental strategy focuses on coordinating different land uses to achieve both physical expansion and economic development. It includes detailed allocations for residential, industrial, commercial, and community facilities, along with an integrated transportation network. Particular emphasis has been placed on optimizing locations for key infrastructure and services to ensure efficient urban functionality. This comprehensive approach ensures that all development aligns with Khairpur's vision for sustainable urbanization and improved quality of life for its residents.

Demographic projections form a crucial basis for the plan as the current projections indicate significant population growth, with density expected to increase from 116 persons per hectare to 175 persons per hectare. To accommodate this expansion, the plan allocates an additional 1,446 hectares for incremental population needs, bringing the total urban land requirement to 4,002 hectares. As Khairpur city enters a new phase of development, this zoning plan provides a clear roadmap for transformation with respect to its existing urban fabric. **Table** 4-5 shows the distribution of proposed land use zones in Khairpur city.

Table 4-5, Proposed Land Use Distribution Percentage for Khairpur (2043)

Level 1 (Zoning)	Level 2 (Sub-Zoning)	Area (Acres)	Percentage Distribution
Residential	Existing Residential	4668.58	27.77%
	Proposed Medium-High Density	813.88	
	Proposed Low-Medium Density	496.18	
Commercial	Existing Commercial	245.83	2.95%
	Proposed High-Density Mixed-Use Zone	388.33	
Parks and Playgrounds	Existing Park/ Recreation	241.41	25.14%
	Proposed City Parks / Recreation	357.67	
	Urban Forestation	3741.31	
	Proposed Recreational Neighborhoods	1072.72	
Institutional	Existing Institutional	753.85	11.50%

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Level 1 (Zoning)	Level 2 (Sub-Zoning)	Area (Acres)	Percentage Distribution
	Proposed Education	263.32	
	Proposed Health and Welfare	769.83	
	Proposed Government/Public Administration	205.32	
	Science Park	484.25	
Utilities And Municipal Service Facilities	Utilities and Municipal Service Facilities	118.20	0.55%
	Proposed Grid Station	0.5	
Religious	Existing Religious	168.72	1.63%
	Proposed Community Centre	30.45	
	Proposed Graveyard Zone	151.38	
Industrial	Existing Industry	287.67	3.79%
	Proposed Industrial Zone	394.67	
	Proposed Special Economic Zone	133.37	
Transportation	Transportation	1364.46	6.34%
Special Areas	Future Extension (Vacant)	1465.92	6.81%
Agriculture and Forestry	Existing Agriculture and Forestry	87.38	9.67%
	Urban Agriculture	1994.11	
Water Bodies	Canals and Drains	829.49	3.85%
	Total	**21528.80**	**100.00%**

Source: *The Consultant Team*

4.7.1 Residential Zone

The proposed master plan prioritizes inclusive housing development by introducing a diverse range of residential options to accommodate all income groups. In line with the National Reference Manual (NRM) standards for cities with populations ranging 500,000 or more people, residential land use is expected to form the dominant component of future urban development. Based on projected population growth, the plan allocates 24% to 32% of the total area for residential purposes, as recommended by the NRM guidelines. The infill development approach fosters compact urban growth that enhances neighbourhood accessibility and walkability while creating more efficient, liveable communities. This strategy focuses on optimizing vacant and underutilized land parcels within contiguous city limits, particularly in core urban areas, to promote infill development rather than horizontal urban expansion. By concentrating growth within the existing urban boundary, the plan achieves multiple sustainable development objectives: preventing urban sprawl, maximizing the use of current

infrastructure and road networks, reducing transportation demands, and maintaining close proximity between housing, employment centres, and social amenities. This approach is expected to partially address the immediate housing needs of incoming migrants seeking better living conditions.

However, the future residential developments are proposed to take place in the form of self-contained neighbourhoods with adequate provisions of streets, open spaces, commercial area, public buildings and other community facilities. The proposed residential areas are categorized into two main groups: Low to Medium Density Residential Zone (L-MDRZ) and Medium to High Density Residential Zone (M-HRDZ). The L-MDRZ is primarily situated at outskirts and/or peri- urban, preserving a low-density development pattern. In contrast, the M-HDRZ is located adjacent to existing built-up areas, aligning with traditional zoning regulations to facilitate development. This deliberate placement aims to minimize disruption to the surrounding areas and ensure compatibility with existing developments.

A. Zoning Regulations for Residential Zone

As per the rules, the residentiary density means the average number of persons residing on or occupying 1 acre of land. Following are the residential densities;

Density Type	Plot Area Sq. yds	Person per Acre	Density Type (consultant)
Density - 01	80	500	Very High Density
Density – 02	> 81 to 120	400	High Density
Density - 03	> 121 to 240	300	Medium Density
Density - 04	> 241 to 400	200	Low Density
Density - 05	>401 to 600	150	Very Low Density
Regional Interim Building and Town Planning, Regulations - 2018, Chapter 20, sub clause 20-3.2.1			

Flats Density as per the average number of persons residing on or occupying 1 acre of land are as follows;

Income Groups	Person per Acre	Density Type (consultant)
Low Income	650	Compact/High-Density Units
Medium Income	500	Moderate/Medium-Density Units
High Income	325	Spacious/Low-Density Units
Regional Interim Building and Town Planning, Regulations - 2018, Chapter 20, sub clause 20-3.2.2,3,4		

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Allocations for various land uses for New Residential Schemes are as follows;

Sr. No	Land Allocation	Area Percentage of Total Land
1	Residential Uses	55%
2	Commercial Uses	5%
3	Roads/Streets	25%
4	Parks And Playground	8%
5	Public Uses (Religious Building and Health Centre)	4%
6	Educational Uses	3%

Source: Regional Interim Building and Town Planning Regulations – 2018 (Chapter 20, sub clauses of 20-4.1)

As per 25-B.2. Building Standards of residential within Sukkur Region shall observe the following standards;

Plot Size (sq. yds.)	Foot Print	No. of Floors (Max)	Minimum Front	Minimum Sides	Minimum Rear
Up to 119	90%	G+2	-	-	-
120-199	80%	G+2	3'-0	-	-
200-299	70%	G+2	3'-0	-	3'-0
300-399	65%	G+2	4'-0	one side-3'-0	3'-0
400-499	65%	G+2	5'-0	one side-3'-0	5'-0
500-999	65%	G+1	7'-0	5'-0	5'-0
1000 and above	60%	G+1	10'-0	5'-0	10'-0

The following guidelines are for residential zone development:

Permitted	Allied Permissible	Prohibited
• Residential Dwelling Units (Houses, Flats, Apartments) • Childcare • Clinics • Small-Scale Education • Places of Worship	• Accessory Buildings • Home Offices • Parks, Playgrounds • Small Scale Commercial shops	• Heavy industrial or polluting enterprises • Large-scale commercial and office complexes • Major transportation facilities (e.g., bus depots, highways) • Waste treatment/disposal sites, large utilities • Nuisance-creating land uses (e.g., livestock farming)

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4.7.2 Commercial Zone

The commercial zone is a vibrant component of the master plan, designed to support economic activity and meet the diverse needs of the city's residents and businesses. As per the Sindh Building Control Act (SBCA) rules the commercial proposal in Khairpur are proposed; 5% maximum commercial activities. The commercial class is categorized into high-density mixed-use zones, cattle markets, grain markets, fruit and vegetable markets, and neighbourhood commercial areas, ensuring a balanced distribution of commercial activities throughout the city.

The major proposals for the boosting the commercial situation in city we have proposed:

High Density Mixed-Use Zone

Taking into account the urban growth patterns and emerging development corridors in Khairpur, the High-Density Mixed-Use Zone has been strategically proposed towards the north on Jail Road and in South on Mirwah Canal Road to accommodate expanding commercial and residential activities. The primary land uses within this zone will include regional business headquarters, financial institutions, media outlets, IT/software houses, high-end retail outlets, and mixed-use commercial buildings with adequate parking and landscaped open areas.

Neighbourhood Commercial

In continuation of the main High-Density Mixed-Use Zone, it is recommended to establish Neighbourhood Commercial Centres to help distribute commercial activity across the town. a Neighbourhood Commercial Centres are proposed within the high-density residential areas to reduce dependency on the main commercial corridor. In addition, small-scale commercial pockets will be integrated within residential neighbourhoods throughout the city to cater to daily retail needs, such as grocery stores, pharmacies, service shops, and other essential goods. These localized commercial areas will enhance accessibility and support walkable communities, improving convenience and quality of life for residents.

A. Zoning Regulations for Commercial Zone

As per 25-B.2. Building Standards of residential within Sukkur Region shall observe the following standards;

Plot Size (sq. yds.)	Foot Print	No. of Floors (Max)	Minimum Front	Minimum Sides	Minimum Rear
Up to 99	90%	G+4	-	Open duct one side of 30 Sq.ft.	-
100 and above	80%	G+5	-	Open duct one side of 30 Sq.ft.	Open duct of 30 Sq.ft.

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Plot Size (sq. yds.)	Foot Print	No. of Floors (Max)	Minimum Front	Minimum Sides	Minimum Rear
Up to 149	90%	G+2	3'-0	-	3'-0
150-499	80%				
240-499	80%	G+2	4'-0	one side-3'-0	3'-0
*500-599	65%(GF) 70%(UF)	G+2	5'-0	one side-3'-0	5'-0
*600- 999	60%	G+1	7'-0	5'-0	5'-0
*1000 and above	65%	G+1	10'-0	5'-0	10'-0

Source: *Regional Interim Building and Town Planning Regulations – 2018*

The following guidelines are for commercial zone development;

Permitted Uses	Allied Permissible Uses
• Corporate Head Office Buildings • Large Markets • Malls, Outlets • Large Public Squares and Parks • Dedicated Parking Lots / Spaces	• Pedestrian friendly streetscape • Mixed-used buildings • Medium to High Rise Apartments • Fuelling stations

4.7.3 Amenities

In Khairpur amenities proposals were proposed upon SBCA standards, stating minimum 7% of land. The proposed amenities include designated zones for education, health and welfare, public administration, a science park, community centers, and graveyards. The details of each proposed zone under the amenities land use category are as follows:

A. Educational Zone

Khairpur city faces significant educational challenges that require immediate intervention. The city's overall literacy rate stands at 68%, with a concerning gender gap of 76% for males compared to just 59% for females. This disparity highlights systemic issues in educational access and quality. The situation is further exacerbated by severe infrastructure deficiencies, where many schools lack proper facilities and face overcrowded classrooms. Current student-classroom ratios reach alarming levels of 49:1 in primary schools and 56:1 in higher secondary institutions, far exceeding recommended UNESCO standards. These challenges demand a comprehensive, strategic approach to education planning and development.

Education Zone Northern

An additional Educational Zone is proposed in Eastern part of Khairpur city, strategically situated along the Shadi Shaheed Road. This location ensures strong regional connectivity and easy access for students and faculty from both within the city and neighbouring settlements. The eastern educational cluster is envisioned to complement the broader academic framework of the

city by hosting institutions focused on contemporary and market-driven disciplines, such as science and technology, business studies, health sciences, IT, and technical and vocational training. Its integration with the surrounding residential fabric will foster a walkable, community-oriented academic environment. This zone aims to broaden educational access, particularly for the local population, and to promote inclusive growth by enabling youth participation in quality education and skill development.

Education Zone Western

A dedicated Educational Zone is proposed in the western part of Khairpur city, strategically located adjacent to the Mirwah Canal, in close proximity to the planned High-Density Mixed-Use Zone. This location has been identified to leverage accessibility, infrastructure, and surrounding urban functions, thereby creating a well-integrated institutional hub. As the city continues to evolve in response to global educational and economic dynamics, there is a growing need to offer academic programs aligned with emerging market demands. The proposed zone will accommodate 20% of its land for institutions specializing in engineering, business administration, finance, media studies, information technology, and software development, among other disciplines. The objective is to establish a centre of excellence that fosters regional youth engagement, enhances educational standards, and supports research and innovation. The remaining 80% supports complementary land uses such as housing, green spaces, and community amenities, creating a balanced ecosystem that integrates learning with liability.

1. Zoning Regulations for Educational Zone

As per 25-B.7. Building Standards of Amenity Plots within All Regions shall observe the following standards;

Sr. No	Plot Size Sq. Yds	Foot Print	Floor Area Ratio (F.A.R)	Minimum Front ft.	Minimum Sides ft.	Minimum Rear ft.
1	Less than 1.0 Acres	50%	1:1.5	10	10	10
2	1.0 Acre and above	50%	1:1.5	15	15	15

The following guidelines are for educational zone development;

Educational Zone		
Permitted Uses	**Allied Permissible Uses**	**Prohibited Uses**
• Large scale educational areas; • (Nursery Schools, Kindergartens, Primary Schools, Secondary Schools, High Schools,	• Staff Residences (teaching and non-teaching) • Separate Hostels for Boys and Girls • Auditoriums,	• Private Residential Housing Schemes • Large Commercial

Educational Zone		
Permitted Uses	**Allied Permissible Uses**	**Prohibited Uses**
Colleges, Special Colleges, Technical Colleges, Universities, Research Institutes, Madrassah) • General Education Universities • Scientific Research Institutes • Engineering colleges / universities • Business and management schools • Finance and accountancy Institutes • IT and media Institutes • City level libraries, book banks, data and information centres	seminar halls, workshop spaces • Community facilities (parks, playgrounds, clinics, schools, neighbourhood commercial) • Support facilities (gym, health club, bus stops, taxi stand, banks, fuelling stations)	Activities
As per SBCA Bylaws the education institutions must be duly charted by Govt. of Sindh and recognized by Higher Education Commission (HEC). The institutions must have a provision of ramp up to ground floor with a minimum width of 4 ft. (1.20m) and maximum gradient 1:12 with a railing at least on one side for disable people.		

B. Health and Welfare Zone

Khairpur city faces a severe healthcare crisis, with medical facilities covering just 0.53% (13.2 sq. km) of urban land, far below the recommended 2–3% standard, to serve its growing population. The city's healthcare system suffers from critical shortages of doctors, inadequate medical equipment, and poor spatial distribution, leading to overwhelmed facilities and high disease rates.

Khairpur's proposed Health and Welfare Zone, a key component of the city's development master plan, aims to allocate urban land for healthcare, ensuring better access and improved public health outcomes.

Health and Welfare Zone Northern

In alignment with Khairpur ' s urban development vision and growing demand for specialized healthcare and wellness services, a Health Neighbourhood is strategically proposed in the northern part of the city, along Jail Road. This location offers excellent connectivity to the city centre and nearby residential areas, while also ensuring accessibility for peripheral and rural populations from the northern belt of Khairpur district. The proposed Health Neighbourhood is envisioned as a dedicated healthcare cluster, anchored around existing health institutions and complemented by new medical, wellness, and allied facilities.

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Health and Welfare Zone Eastern

A Health Neighbourhood is proposed along Shadi Shaheed Road, in the eastern part of the city. This corridor is rapidly emerging as a key urban expansion zone, offering ample land availability, direct connectivity to inner-city roads, and access from surrounding rural talukas. The Health Neighbourhood will serve as a comprehensive medical and wellness district, anchored by mid-to-large-scale healthcare infrastructure and supported by public amenities.

Health and Welfare Zone Southern

As Khairpur continues to urbanize and expand southward, a Health Neighbourhood is strategically proposed along Muhabbat Wah Canal Road, forming a vital part of the city's health infrastructure network. This southern corridor benefits from scenic canal-side views, less congestion, and proximity to developing residential zones making it ideal for a health-focused urban precinct. The proposed Health Neighbourhood along Muhabbat Wah Canal Road is envisioned as a tranquil, wellness-oriented healthcare zone, designed to integrate clinical services with natural green surroundings to support both curative and preventive care.

Health and Welfare Zone Western

To ensure balanced healthcare access across all zones of Khairpur, a Health Neighbourhood is strategically proposed in the western part of the city, located near Mirwah Canal and along the proposed upgradation road corridor. This location lies within reach of expanding suburban settlements and connects to the city's rural-western periphery, making it a critical healthcare anchor for underserved populations. The peaceful environment along the Mirwah Canal, coupled with the potential of improved road infrastructure, provides an excellent setting for a nature-integrated, inclusive healthcare cluster that supports long-term recovery, wellness, and community care.

1. Zoning Regulations for Health and Welfare Zone

As per 25-B.7. Building Standards of Amenity Plots within All Regions shall observe the following standards;

Sr. No	Plot Size Sq. Yds	Foot Print	Floor Area Ratio (F.A.R)	Minimum Front ft.	Minimum Sides ft.	Minimum Rear ft.
1	Less than 1.0 Acres	50%	1:1.5	10	10	10
2	1.0 Acre and above	50%	1:1.5	15	15	15

The following guidelines are for Health and Welfare Zone development;

Permitted Uses	Allied Permissible Uses	Prohibited Uses
• Large Hospitals • Specialized treatment centers • Medical College • Dental College • Pharmaceutical College • Nursing College • Laboratories and Diagnostic Centers • Blood Banks • Health Research Institutes	• Staff Residences (medical and paramedic) • Separate Hostels for Boys and Girls • Auditoriums, seminar halls, workshop spaces • Community facilities (parks, • playgrounds, schools, clinic, • neighbourhood commercial) • Support facilities (gym, health club, bus stops, taxi stand, banks, fuelling stations)	• Private Residential Housing Schemes • Large Commercial Activities
The institutions must have a provision of ramp up to ground floor with a minimum width of 4 ft. (1.20m) and maximum gradient 1:12 with a railing at least on one side for disable people.		

C. Public Administration Zone

Khairpur city's rapid urbanization and growing population necessitate the creation of a new, well-planned administrative zone to address current challenges in governance, service delivery, and urban sprawl. The existing administrative offices are concentrated in the congested city centre, leading to accessibility issues, traffic bottlenecks, and inefficient public service delivery. The proposed public administration zone serves as the administrative and governance hub of the city, government offices, civic institutions, and public service facilities, designated along southern side of Mirwah Canal Road in the northern side of city for better accessibility.

The zone integrates municipal buildings, police stations, fire departments, post offices, and other critical institutions to ensure effective governance and public service delivery. Civic spaces, including town halls and public squares, are designed to foster community engagement and participation in local governance, while the infrastructure is carefully planned to ensure smooth transportation, ample parking, and pedestrian-friendly pathways for easy accessibility. Additionally, dedicating space for private sector offices, such as banks, corporate services, and development firms, would foster economic activity and reduce the haphazard mixing of commercial and residential land uses seen in the old city. This zone plays a critical role in maintaining order, delivering public services, and fostering trust between the government and its citizens, ensuring a well-organized and responsive urban environment.

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1. Zoning Regulations for Public Administration Zone

As per 25-B.7. Building Standards of Amenity Plots within All Regions shall observe the following standards:

Sr. No	Plot Size Sq. Yds	Foot Print	Floor Area Ratio (F.A.R)	Minimum Front ft.	Minimum Sides ft.	Minimum Rear ft.
1	Less than 1.0 Acres	50%	1:1.5	10	10	10
2	1.0 Acre and above	50%	1:1.5	15	15	15

The following guidelines are for Public Administration zone development;

Public Administration Zone		
Permitted Uses	**Allied Permissible Uses**	**Prohibited Uses**
• District Secretariat • Development Authority Town Committee Complex • Line Departments • Local Government Offices • Town Planning Department • Judiciary Complex • Circuit House	• Employees Residences (for all grades) • Auditoriums, seminar halls, workshop space • Community facilities (parks, playgrounds, clinics, schools, neighbourhood commercial) • Support facilities (gym, health club, bus stops, taxi stand, banks, fuelling stations)	• Private Residential Housing Schemes • Large Commercial Activities
The institutions must have a provision of ramp up to ground floor with a minimum width of 4 ft. (1.20m) and maximum gradient 1:12 with a railing at least on one side for disable people.		

D. Science Park

The science park is envisioned as a dynamic and innovative hub within the master plan, designed to foster research, development, and technological advancement. This zone allocates 20% of its land to high-order facilities such as software houses, skill/ IT based research institutions, technology incubators, and innovation centres, while the remaining 80% supports complementary land uses like office spaces, green areas, and residential accommodations for researchers and professionals. It is strategically located near major transport corridor specifically along southern side of Mirwah Canal Road, adjacent to shah Abdul Latif University, along Sohu Kanaseerah Road adjacent to Police Training Centre. The science park promotes collaboration between academia, industry, and government, driving economic growth and technological innovation.

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The zone will feature state-of-the-art laboratories, conference facilities, and co-working spaces, creating an ecosystem that encourages knowledge sharing and entrepreneurship. By attracting talent, investment, and cutting-edge projects, the science park aims to position the city as a leader in science and technology, fostering a culture of innovation and contributing to long-term economic and social development.

1. Zoning Regulations for Science Park

The following guidelines are for Science Park development;

Permitted Uses	Allied Permissible Uses	Prohibited Uses
• Educational and Research Institutions • Offices of Social and Cultural Organizations • Software houses and IT firms • Research and development institutions • Technology incubators and innovation centers • Skill development and training centers • Approved Parking Provisions • Research centers • Libraries	• Office spaces for technology-related businesses • Food courts • Petrol and gas filling Station Parks, Memorials and Monuments • Day Cares • Public Utilities and Buildings Taxi Stands, Bus Halts • Residential accommodations for researchers and professionals Co-working spaces	• Other than permitted and permissible
The institutions must have a provision of ramp up to ground floor with a minimum width of 4 ft. (1.20m) and maximum gradient 1:12 with a railing at least on one side for disable people.		

E. Community Centre

As part of the proposed land use plan, the Community Centre is envisioned as a dynamic, multi-purpose facility that addresses the divine, social, and developmental needs of residents. It will include dedicated spaces for religious practices, community events, and essential support services. In addition to serving as a venue for worship and celebrations, the centre will also actively promote interfaith dialogue, cultural interaction, and lifelong learning. Strategically positioned adjacent to central prison and correctional facility, along the Jail Road, the centre is designed to foster social cohesion and improve community well-being.

1. Zoning Regulations for Community Centre

The following guidelines are for Community center development;

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Permitted Uses	Allied Permissible Uses	Prohibited Uses
• Spaces for religious practices (e.g., prayer areas) Community gatherings and events Educational and skill development programs Cultural and recreational activities	• Administrative offices Health and social support services Small-scale food kiosks or cafés Temporary shelters during emergencies	• Industrial or manufacturing activities Permanent residential units Commercial plazas or large-scale retail operations Entertainment venues unrelated to community welfare
The institutions must have a provision of ramp up to ground floor with a minimum width of 4 ft. (1.20m) and maximum gradient 1:12 with a railing at least on one side for disable people.		

F. Graveyards Zone

The graveyards in Khairpur city currently cover 15.14 hectares (1.48% of urban land), with major cemeteries concentrated around DCO Road, Khayaban-e-Shafi Road, and northern Khanan Shah Road. These sites face increasing pressure from urban growth, with limited expansion potential due to surrounding development. Current challenges include overcrowding, poor access (particularly noticeable along the Mirwah Canal Road which lacks any cemetery), and inconsistent maintenance.

To address these issues, a new graveyard zone is strategically designed to address both immediate and long-term needs for burial spaces in the city. It is proposed on the northeastern and southern sides of the city. This zone also follows a strategic framework of 80% residential use and 20% dedicated solely to graveyard purposes. This allocation not only optimizes land use but also integrates the graveyard zone within a broader residential context, making it accessible and respectful of community needs. By establishing this zone, the city aims to provide a long-term solution for burial space while enhancing the surrounding residential areas.

1. Zoning Regulations for Graveyards Zone

The following guidelines are for Graveyard zone development;

Permitted Uses	Allied Permissible Uses	Prohibited Uses
• Graveyard Area	• Related commercial activities • Accommodation for caret	• Other than permitted and permissible

4.7.4 Industrial Zone

The existing industries (brick kilns, and warehouses) in Khairpur city is concentrated along National Highway (N-5) and Rohri Canal, forms the backbone of the local economy but suffers from haphazard development and infrastructure limitations. As per the NRM standards for Khairpur 2% to 15% land is proposed to be allocated for industrial use. New proposals include the development of a dedicated Special Economic Zone (SEZ), positioned along the National Highway (N-5) adjacent to Khairpur Interchange to address current city's growth patterns. By strategically locating these zones along emerging development corridors, the plan will both upgrade traditional industries through modern facilities and clustering, while introducing higher-value sectors like food processing and renewable energy that complement Khairpur's agricultural strengths.

This integrated approach promises to transform the current pattern of industrial activity into an organized economic engine, creating thousands of formal jobs, attracting new investment, and improving linkages to transportation networks. The initiative represents a key opportunity to build upon Khairpur's established industrial base while steering its economic future toward more sustainable and diversified growth.

A. Zoning Regulations for Industrial Zone

As per 25-B.6. Building Standards of Industrial Plots within All Regions shall observe the following standards;

Sr. No	Plot Size Sq. Yds	Foot Print	F.A.R.	Minimum Front ft.	Minimum Sides ft.	Minimum Rear ft.
1	Up to 1100	70%	1:2.5	8	5 one side	10
2	1101 to 2500	70%	1:2.5	10	10 each side	10
3	2501 to 20000	65%	1:2	20	15 each side	15
4	20001 to 30000	60%	1:2	20	15 each side	20
5	30001 to 45000	60%	1:1.5	30	15 each side	20
6	Above 45000	60%	1:1.5	30	15 each side	45
Plots below 1100 Sq. Yds. shall not be allowed for use of heavy Industry, except cottage industry. However, on plot less than 1100 Sq. Yds., the approval for medium industry shall be allowed subject to NOC of Industries Dept: GoS.						

Allocations for various land uses for new industrial towns and estates are as follows;

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Sr. No.	Land Allocation	Area Percentage of Total Land
1	Industrial area	70%
2	Commercial area	1%
3	Roads/Streets	20%
4	Parks And Playground	3%
5	Public Uses (Religious Building and Health Centre)	6%
6	Educational Uses	3%

Source: *Regional Interim Building and Town Planning Regulations – 2018 (Chapter 20, sub clauses of 20-4.2.4)*

Industrial Plots (Regional Interim Building and Town Planning Regulations - 2018 (Chapter 20, sub clauses of 20-4.2.4 ,5)
On industrial plots of 5 acres and more, 8% of the total plot area in the rear shall be allowed for residential, local commercial, amenity, road etc. within the premises for labour and staff for which a separate approach shall have to be provided. The minimum distance between the factory and residential units shall be at least 40 ft. (12.18m.)
In any industrial area, no road shall be less than 50 ft. (15.22m) in width for areas allocated for large and medium industries and no less than 40 ft. (12.18m) for area allocated for small industries.

The following guidelines are for Industrial Zone development;

Permitted Uses	Allied Permissible Uses	Prohibited Uses
• Large-scale manufacturing/ heavy industry • Small-scale manufacturing/ light industry • Wholesale uses: warehousing, godowns, and wholesale markets	• Showrooms • Mixed-used buildings • Residences for workers • Fuelling stations	• Private Residential housing schemes • Large health and educational institution

4.7.5 Recreational Zone

Khairpur City suffers from a severe shortage of recreational spaces, with parks and open areas covering only 0.8% of the urban landscape, far below the 8% standard recommended by the Sindh Building Control Authority (SBCA). The few existing facilities, such as Bilawal Bhutto Park, Sadar Din Shah Family Park, Dilshad Park, Ladies Park, etc., are insufficient to serve the growing population and are unevenly distributed, leaving large sections of the city without accessible green spaces. Many residents, particularly in southern and northern neighbourhoods, lack parks within a reasonable walking distance,

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failing to meet international benchmarks set by WHO (9m² per person) and UN-Habitat (800m accessibility). Compounding the problem, several existing parks suffer from poor maintenance, inadequate lighting, and a lack of basic amenities, reducing their usability and appeal.

To address these challenges, Khairpur's urban development strategy prioritizes expanding and strategically locating recreational zones to create a healthier, more liveable city. Recreational zone includes a variety of green spaces such as city parks for both active and passive recreational facilities, urban forestry along major roads and canals, and preserved orchards. Neighbourhood-level parks and open spaces are also incorporated to ensure accessibility for local communities. The main city park is strategically located on the southwestern and northern side of Railway line along Rohri Canal adjacent to MUET and adjacent to Waryal Shah Graveyard on the eastern side of city, while recreational neighbourhoods along National Highway (N-5), Phatak Road, Sohu Kanaseerah Road, Civil Hospital Road, or etc., are proposed to equitably fulfill the recreational requirements of the entire community throughout the city. In recreational neighbourhood zone, 80% of the area is designated for housing, while 20% is allocated for recreational purposes, including mohalla and neighbourhood parks. Overall, 20% of the city's total area is reserved for recreational land use, underscoring its pivotal role in creating a balanced, vibrant, and liveable urban structure.

A. Zoning Regulations for Recreational Zone

The following guidelines are for Recreational zone development;

Permitted Uses	Allied Permissible Uses	Prohibited Uses
• City scale parks • Large public squares • Sports facilities • Cultural activities • Amusement area • Special theme parks • Regional level gardens like botanical, zoological	• Ancillary structures • Accommodation for caretakers / workers • Related commercial activities • Fuelling stations • Parking • Public washrooms	• Other than permitted and permissible

4.7.6 Urban Forestation Zone

Urban forestation is a crucial initiative aimed at preserving and enhancing green spaces within densely populated areas, particularly those rich in orchards and agricultural fields. To achieve this, it is essential to prioritize urban forestation in areas already characterized by high densities of orchards and green fields. This approach not only preserves existing ecosystems but also enhances biodiversity. Additionally, strict zoning regulations should be implemented to limit development in these designated areas, ensuring that existing orchards within the planning boundary are protected and integrated into the urban forestation plan.

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To safeguard critical infrastructure, such as main canals and primary roads, a mandatory 50-feet urban forestation buffer on both sides is proposed. This strategy serves dual purposes: it protects the motorway from uncontrolled development and contributes to the city's greenery. To ensure compliance, it is vital to make these buffer zone regulations legally binding, reinforcing the commitment to maintaining green spaces and protecting infrastructure.

Another important aspect of urban forestation is strategic planting along transportation corridors. Urban forestation along canals and major roads should be tailored to the Right of Way specifications. This will not only increase the overall green area in the city but also prevent direct development along these critical transport routes. Engaging local communities in these planting initiatives can further enhance the success of such projects by fostering a sense of ownership and stewardship over these green spaces.

A. Zoning Regulations for Urban Forestation Zone

The following guidelines are for Urban Forestation Zone development;

Permitted Uses	Allied Permissible Uses	Prohibited Uses
• Horticulture • Landscaping • Plantation • Green belts • Urban forestation	• Related land use and activities, while no land development or buildings • Temporary accommodation for labor and security persons • Specific parking area for any accident and unplanned incident.	• Land development for commercial or residential purposes • Construction of permanent buildings • Industrial or high-traffic activities

4.7.7 Agricultural Zone

To manage urban expansion effectively, all areas beyond the designated planning boundary have been classified as agricultural zones. This strategic designation aims to contain the city's growth, preserving valuable farmland and promoting sustainable land use practices. By limiting urban development in these regions, the plan seeks to maintain the ecological balance and ensure that agricultural activities continue to thrive, ultimately supporting local food production and community resilience.

A. Zoning Regulations for Agricultural Zone

The following guidelines are for agricultural zone development;

Permitted Uses	Allied Permissible Uses
• Land use for proposed agricultural and its necessities.	• Related land activities with respect to its rules and regulations • Accommodation for farmers and labor in associations with MC.

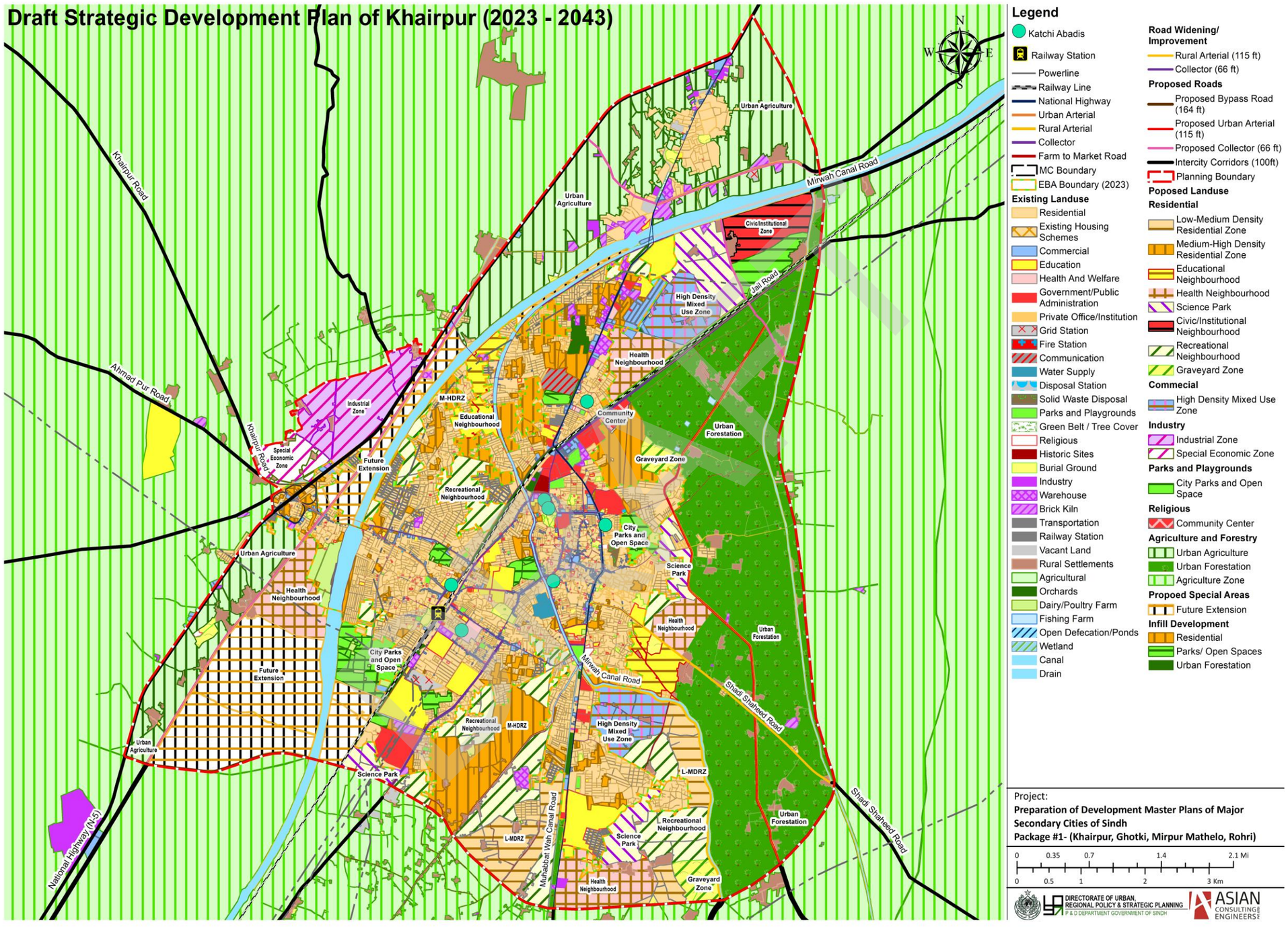


Figure 4-8, Draft Strategic Development Master Plan of Khairpur (2023-2043)

Source: *The Consultant Team*

SECTION - 5: HOUSING

5.1 Introduction

This section outlines a strategic approach to address the city's housing challenges, starting with an assessment of current conditions, including quality, distribution, and service access. A SWOT analysis identifies key sectoral strengths and gaps, while future housing needs are projected based on population growth. Land Suitability Analysis (LSA) supports the identification of areas for residential expansion. Based on these insights, policy recommendations and a Strategic Development Plan are proposed, along with priority projects and an Immediate Action Plan to meet urgent needs and promote sustainable, inclusive housing development.

5.2 Existing Situation

The current state of housing in Khairpur city is similar to the situation nationwide. Khairpur is a rapidly growing urban area. Along with the natural increase in the local population, a significant number of immigrants from nearby villages are also contributing to the city's population every year. Housing and other basic municipal services in Khairpur are often below standard. The situation has worsened as the urban population has grown. Despite an increase in the quantity of housing supply over the years, the condition of housing in Khairpur remains inadequate.

According to the socio-economic survey 2023, the current situation in Khairpur city shows that a major proportion of dwellings are built using sun dried bricks, with only a few Katcha houses. The majority of the residents live in family-owned residences built between 6 to 20 years ago. Due to cultural and financial considerations, the predominant plot size is 81-120 sq. yard., and residents prefer to build ground floor and single-story dwellings. In the city, two-room dwellings are the most frequent.

Mostly the houses are equipped with natural gas in case of non-availability and load shedding wood is the major source for cooking fuel. More than half of the households utilise hand pumps for water supply inside their homes, while only a few have access to piped water supply. As far as condition of drainage system is concerned, the overall situation isn't satisfactory, half of the households have drainage system while others haven't.

5.3 Available Housing Stock

The quality of existing housing stock in Khairpur city is an important consideration in evaluating the adequacy of the existing housing stock and predicting future housing requirements. Condition and age of the residential units are two of the physical characteristics of the housing supply which reflects the quality of housing.

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Tenure, height of building, plot size, number of rooms, and affordability are other variables which determine the general status of the housing supply. The condition of housing within an area also influences the decision for investment in new or planned housing. The existing housing stock for 2023 estimated from the 2017 census is shown in the **Table** 5-1 and the quality of the existing housing stock is analysed by the data collected from socio-economic survey 2023.

Table 5-1, Estimated Current Housing Stock in Khairpur City

Current Housing Stock in Khairpur City	
Population (2017)	183,120
Urban Extent Population (2023)	263,645
Housing Units (2017)	31,397
Household Size (2017)	5.74
Required Housing Units (2017)	31,902
Housing Backlog (2017)	505
Percentage of Backlog (2017)	1.6
Household Size (2023)	5.28
Required Housing Units (2023)	49,933
Estimated Housing Backlog (2023)	804
Existing Estimated Housing Units (2023)	49,129

Source: *Pakistan Bureau of Statistics and Consultant Team*

5.4 Katchi Abadis of Khairpur

Khairpur city is grappling with significant challenges stemming from unplanned urban development. The inner core of the city has seen the rise of densely populated areas, notably Talpur Colony, Citizen Colony, New Citizen Colony, Burghari and Darbar Mohalla. These neighbourhoods are marked by chaotic construction and insufficient infrastructure, leading to rapid population growth without adequate urban planning measures. Residents face issues such as narrow, congested lanes, poor sanitation, and limited green spaces, which detrimentally affect their quality of life. To tackle these challenges, a comprehensive approach involving urban planning, infrastructure enhancement, and community engagement is essential.

Besides those areas around 07 notified Katchi Abadis are identified in the Khairpur city their locations are shown in the below **Table** 5-2. Generally, all these Katchi Abadis are along the major transport corridors and are scattered haphazardly in the centre and on the outskirts of the city. Majority of the land use of these Katchi Abadis are residential and is surrounded by nearby community facilities except Faizabad Colony which is located on the outskirts of the city making a very less presence of other important land uses

such as commercial and other public amenities. These Katchi Abadis lie in medium to highly dense areas and the houses are very close to each other with irregular development pattern, which is unsafe for the residents and deteriorate the quality of life. Also, the roads and streets are very narrow for vehicles to pass, which may create problem for evacuation during the time of any emergency.

Human Settlement Authority (HSA) formerly known as Sindh Katchi Abadis Authority (SKAA) has the power to implement policies formulated by government for the development or improvement of the areas of the Katchi Abadis and regularization of such Katchi Abadis.

Table 5-2, Notified Katchi Abadis in Khairpur City

Sr. No.	Names	Location
1	Faizabad Colony	Along National Highway
2	Shahedabad	Along DCO Road
3	Khanan Shah Colony	Along DCO Road
4	Jinnah Colony	Along National Highway
5	Village Shaman Ali Sheikh	Along Station Road
6	Madina Colony	Along Phatak Road
7	Banarsi Colony Extension	Along Civil Hospital Road

Source: *The Consultant Team*

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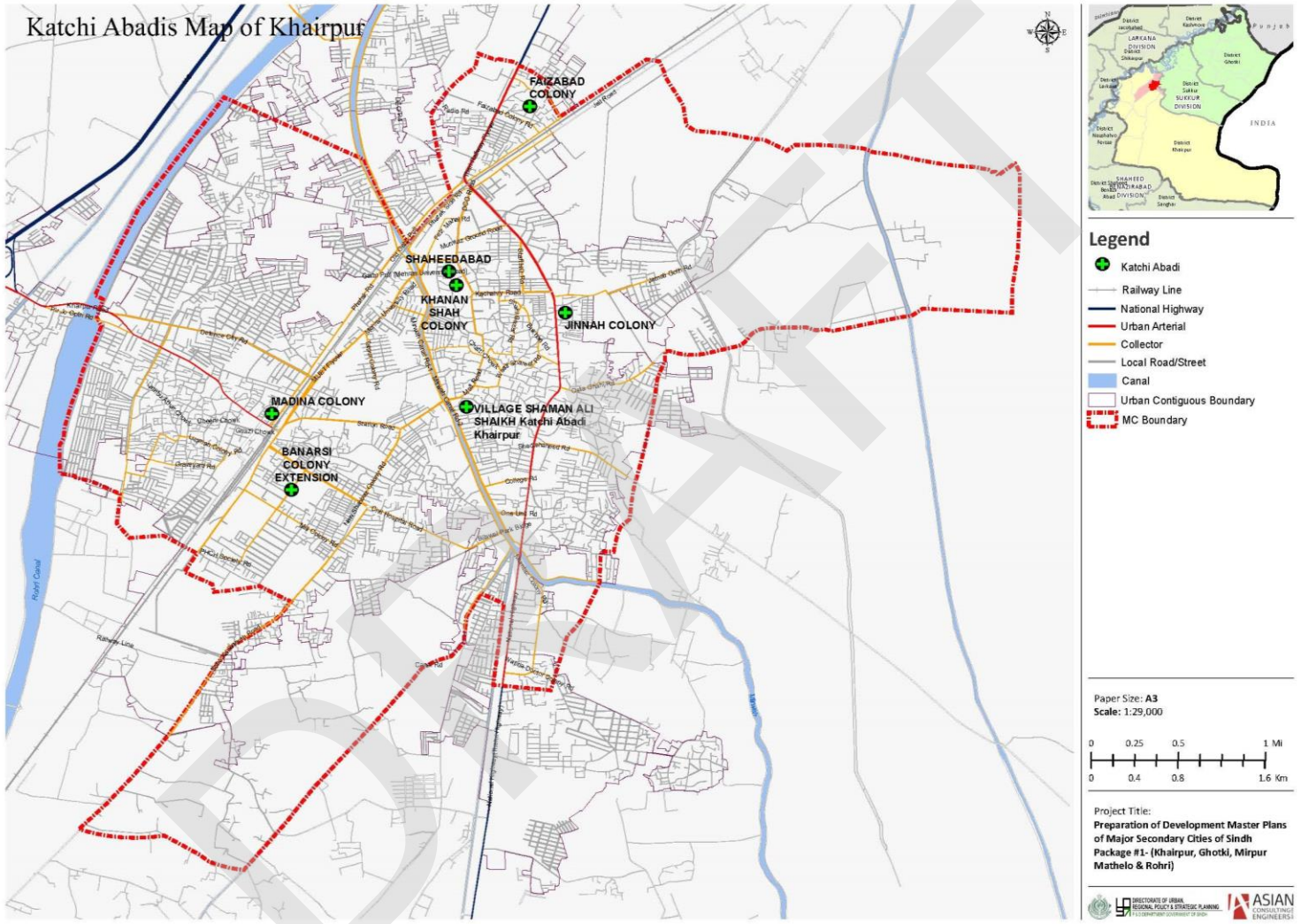


Figure 5-1, Location of Notified Katchi Abadis - Khairpur City

Source: *The Consultant Team*

5.5 SWOT Analysis

Strength	Opportunities
Presence of planned layouts indicates for organized urban development	Vacant land can be used for infill development to minimize horizontal expansions
Weaknesses	**Threads**
Mushroom Growth (unknown status of PHS) Poor Building topology	Policy issues Land Speculation Lack of implementation of building byelaws

5.6 Need Assessment

5.6.1 Housing Demand for the Project Period

Based on the estimated population data of 2023, the housing demand for Khairpur city (2023-2043) is estimated to be 39,837 dwelling units, assuming an average household size of 5.28 persons. The housing demand for the planning period has been calculated by considering factors such as housing backlog, new demand generated due to increase in population and the availability of the vacant housing stock in the city. The years wise housing demand is shown below in **Table** 5-3**.**

Table 5-3, Five Year interval wise Housing Demand (2023-2043)

Year	Incremental Population	Average household size (DCR-2023)	Housing Demand
2028	40,955	5.28	7,757
2033	47,317		8,961
2038	54,667		10,354
2043	63,159		11,962
Housing Demand based on population projections 2023-2043			39,033
Estimated Housing Backlog 2023			804
Total Housing Demand 2023-2043			**39,837**

Source: *PBS and The Consultant Team*

5.6.2 Residential Land Suitability Analysis

Land suitability analysis (LSA) for residential development in Khairpur city focuses on evaluating various factors such as topography, proximity to infrastructure, environmental conditions, and existing land use, etc., to determine the best locations for housing, particularly emphasizing areas along major primary and secondary roads and existing settlements. Suitable residential areas (**Figure** 5-2) are often found near main networks such as National Highway and Railway Line, which provide essential access to

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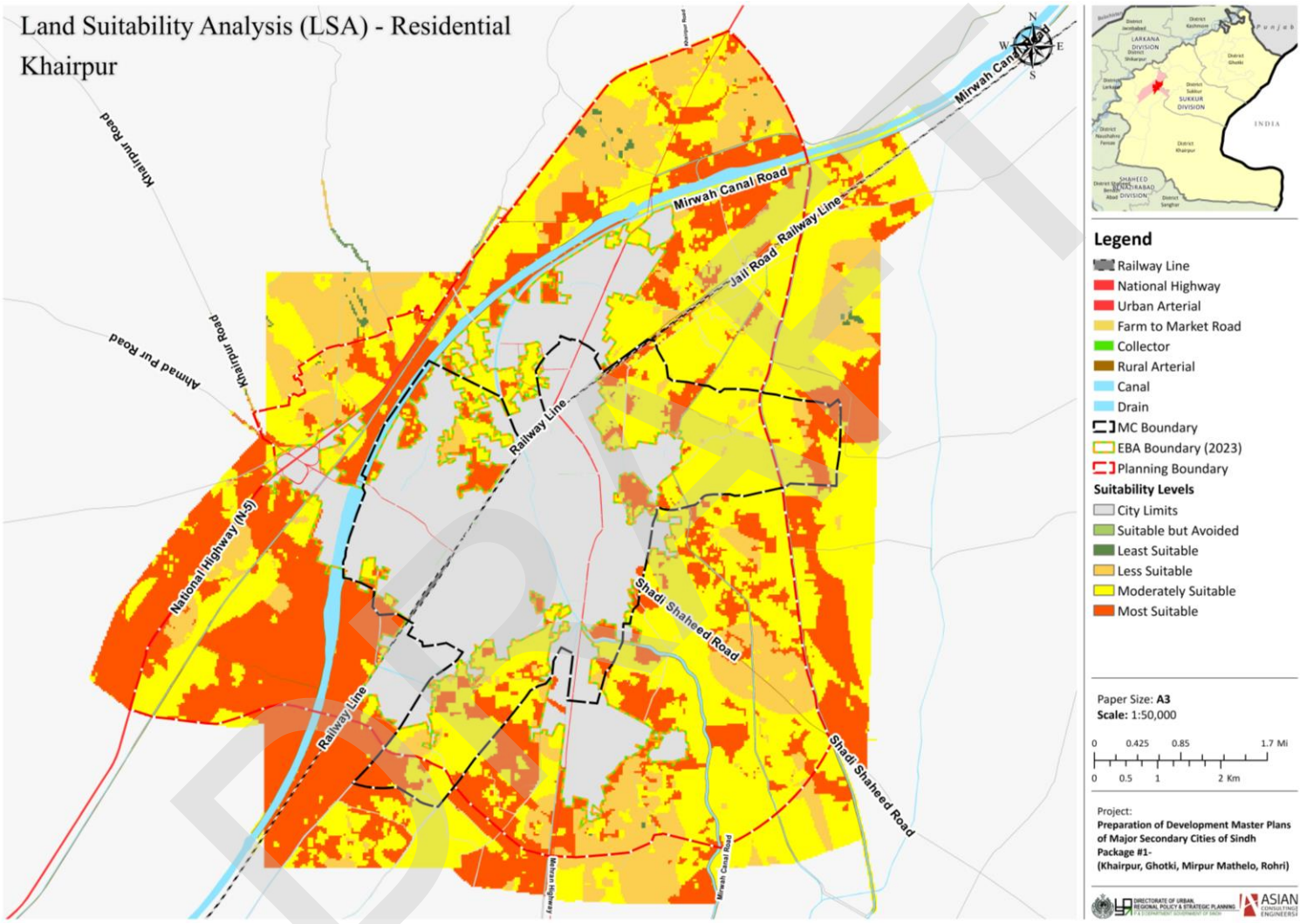


Figure 5-2, Land Suitability Analysis - Residential

Source: *The Consultant Team*

transportation, services, and amenities, enhancing the convenience for residents. Additionally, proximity to infrastructure such as utilities and social services is crucial, as it reduces development costs and improves overall liveability. Areas that are within a distance of 200 to 1000 meters from major roads such as Mirwah Canal Road, Jail Road as well as other secondary roads, are generally considered optimal for residential use, balancing accessibility with the need to avoid excessive noise and pollution from traffic. Furthermore, the presence of existing residential neighbourhoods, such as the Town Committee Therhi, north of Khairpur, could indicate desirable locations for new developments. These neighbourhoods often reflect established community dynamics and have infrastructure support.

5.7 Policy Guidelines

The housing sector in Khairpur city must be developed in alignment with existing laws, policies, rules, and regulations at the federal, provincial, and local levels. The following policy guidelines are framed with respect to the available legal framework to ensure effective implementation and compliance:

5.7.1 Policy Measures for Land

Priority Identification of Land for Housing

Under the Sindh Land Revenue Act (1967), provincial and local authorities must identify state and private lands suitable for housing. Private developers shall be engaged in this process through public-private partnerships (PPPs) to ensure market-driven land allocation while preventing speculative hoarding. Priority will be given to urban areas with existing infrastructure to minimize development costs.

Land Acquisition

The Land Acquisition Act (1894) governs land acquisition for public housing schemes, ensuring fair compensation at market rates. For private housing schemes, developers must negotiate directly with landowners under Sindh Real Estate Regulatory Authority (SRERA) guidelines to prevent forced evictions and ensure transparency.

Land Information System

As mandated by the Sindh Land Revenue Act (1967), a GIS-based land information system shall be developed to maintain accurate records of land inventory, classification, and availability, with regular updates to reflect changes in ownership, land use, and settlement patterns.

Land Registration and Tenure System

Under the Sindh Land Revenue Act (1967) and Sindh Katchi Abadis Act (1987), informal and customary land tenure systems shall be rationalized into a formal, registered social contract, providing secure land titles to residents of Katchi Abadis and informal settlements.

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5.7.2 Policy Measures for Housing Finance

Encouraging Financial Institutions

In line with the State Bank of Pakistan (SBP) regulations and the Mera Pakistan Mera Ghar (MPMG) program (initiated in 2020), financial institutions shall be encouraged to provide low-interest mortgage loans to low- and middle-income groups, while microfinance institutions shall offer small loans for housing construction and improvements.

Subsidized Housing

Under federal and provincial housing policies, subsidies will prioritize urban housing schemes. A cross-subsidy model will be implemented, where revenue from high-value commercial plots in private developments funds low-income housing units. Additionally, subsidized loan facilities will support rural housing construction and improvements through microfinance institutions such as Khushhali Bank and Zakat funds.

5.7.3 Policy Measures for Katchi Abadis, Squatter Settlements, and Slums

Regularization and Upgradation

Under the Sindh Katchi Abadis Act (1987), Katchi Abadis shall be regularized, providing residents with legal ownership rights, while infrastructure upgrades, including water supply, sanitation, and electricity, shall be implemented to improve living conditions.

Relocation of Hazardous Settlements

In compliance with the Sindh Katchi Abadis Act (1987) and National Disaster Management Authority (NDMA) Guidelines, Katchi Abadis located in hazardous zones, such as flood-prone areas, near railway tracks, or under high-tension power lines, shall be relocated to safer areas with proper compensation and resettlement support.

5.7.4 Policy Measures for Low-Income Housing

Reservation of Plots for Low-Income Groups

In all government and private housing schemes, 20% of plots shall be reserved for low-income groups and offered at affordable prices, as per the Sindh Local Government Act (2013). Private developers shall be incentivized to develop low-cost housing schemes through tax breaks and land subsidies.

Incremental Housing Plans

Under the Sindh Building Control Ordinance (1979) and Sindh Local Government Act (2013), building bylaws and planning standards shall be revised to permit incremental development, making housing more affordable for low-income groups, and local governments shall prepare housing plans to address current and future housing needs.

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Infrastructure Provision

As per the Sindh Local Government Act 2013 (amended in 2021), all approved housing schemes will be provided with fundamental amenities such as piped water, sewerage, electricity, and gas connections, in collaboration with the appropriate authorities to ensure prompt infrastructure development. According to SRERA regulations, private developers are required to offer water, sewerage, electricity, and roads before selling plots. Failure to comply will result in project blacklisting and financial penalties.

5.7.5 Policy Measures for Disaster-Resilient Housing

Flood-Resilient Designs

Under the Sindh Building Control Ordinance (1979) and NDMA Guidelines, flood-resistant materials and elevated housing designs shall be promoted in flood-prone areas, and local builders and contractors shall be trained in disaster-resilient construction techniques.

Insurance Schemes

Affordable housing insurance schemes shall be introduced under the Sindh Insurance Ordinance (2000) to protect homeowners from losses due to natural disasters.

5.7.6 Policy Measures for Monitoring and Evaluation

Anti-Speculation Measures

The Sindh Prohibition of Housing Schemes and Land Subdivision (Unregulated) Act (2021) bans unauthorized housing schemes. Developers must complete construction within 5 years of land acquisition, or plots shall be auctioned to prevent artificial shortages.

Regular Audits

In compliance with the Sindh Transparency and Right to Information Act (2016), regular audits of housing projects shall be conducted to ensure compliance with policies and standards, promoting transparency and accountability.

Performance Metrics

As per the Sindh Local Government Act (2013), performance metrics shall be developed to evaluate the success of housing initiatives, enabling data-driven improvements and ensuring effective resource allocation.

Feedback Mechanisms

Under the Sindh Transparency and Right to Information Act (2016), feedback mechanisms shall be established to gather input from residents, ensuring that housing policies and projects are responsive to community needs and expectations.

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5.8 Strategic Development Plan

By 2043, the city's population is projected to grow by 510,921. To accommodate this, a structured plan will guide development within existing urban areas and expansion zones, ensuring sustainable growth. A 360 hectares residential zone is proposed in the northwestern, northeastern, and southern side of city, strategically located near arterial roads for easy access to key urban centres and employment hubs. The aim of this Strategic Development Plan is to facilitate the provision of housing, infrastructure, and urban amenities, particularly for the poor and deprived population in Khairpur city. The following strategies need to be focused on:

5.8.1 Strategic Focus Areas

- Enhance the capacity of the Municipal Committee Khairpur to enforce building bylaws and prevent illegal encroachments (e.g., unplanned settlements along the National Highway).
- Establish a dedicated Khairpur Housing Task Force under the Sindh Katchi Abadi Authority (SKAA) to fast-track regularization of Khairpur's Katchi Abadi and prevent new slums.
- Implement incremental housing schemes modelled on successful examples such as Orangi, Qasba, and Khuda Ki Basti to promote low-cost and sustainable housing options.
- Offer tax exemptions to developers building low-cost housing in the proposed southwest expansion zone.
- Reduce property transfer taxes for first-time homebuyers in Khairpur to encourage formal housing demand.

A. Long-Term Plan

- Develop new residential zones in northwest Khairpur (along National Highway and Mirwah Canal Road) to absorb population growth, linked to job hubs (e.g., Mehran University, SALU, and industrial areas) via dedicated shuttle services.
- Reserve 30% of plots (80 -120 sq. yd.) in new schemes (e.g., Faizabad Colony Extension, Burghari North) to match 39% of households preferred plot sizes (Socio-Economic Survey 2023).
- Land subsidies for developers in proposed expansion zones (see **Figure** 5-3), with mandatory 30% low-income housing to ensure affordability.
- Legalize 7 notified Katchi Abadis (e.g., Faizabad Colony, Jinnah Colony) under the Sindh Katchi Abadis Act (1987), providing lease rights and basic services (water, sewage, electricity).
- Relocate high-risk settlements (e.g., flood-prone areas near Rohri Canal) to safe zones with compensation and rehabilitation support.

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- Partner with Khushhali Bank Sukkur to offer interest-free loans (Akhuwat model) for home expansions in core areas (e.g., Darbar Mohalla, Talpur Colony).
- Promote flood-resistant designs (raised plinths, bamboo-reinforced concrete) in riverine zones (near Indus River).
- Mandate solar-powered units in new housing schemes to counter energy shortages.

B. Short-Term Plan

- Repair crumbling sewer lines in old city areas (20% houses >30 years old).
- Extend water pipelines to eliminate tanker dependency in central areas of Khairpur.
- Pave alleys with brick tiles in dense settlements (e.g., Burghari, Citizen Colony) to improve drainage and reduce dust.
- Install communal water points and underground drains in Katchi Abadis (e.g., Madina Colony, Banarsi Colony).
- Demolish unsafe buildings (per Sindh Building Control Ordinance) in core zones, with owner notifications.
- Develop green medians along Jail Road, DCO Road to reduce pollution.
- Install solar-powered LED streetlights with motion sensors in residential/commercial areas.
- Promote rooftop gardens in high-density neighborhoods (e.g., Phatak Colony).
- Strengthen MC Khairpur's capacity to enforce building bylaws and prevent encroachments.
- Launch GIS-based land monitoring to track illegal housing schemes.

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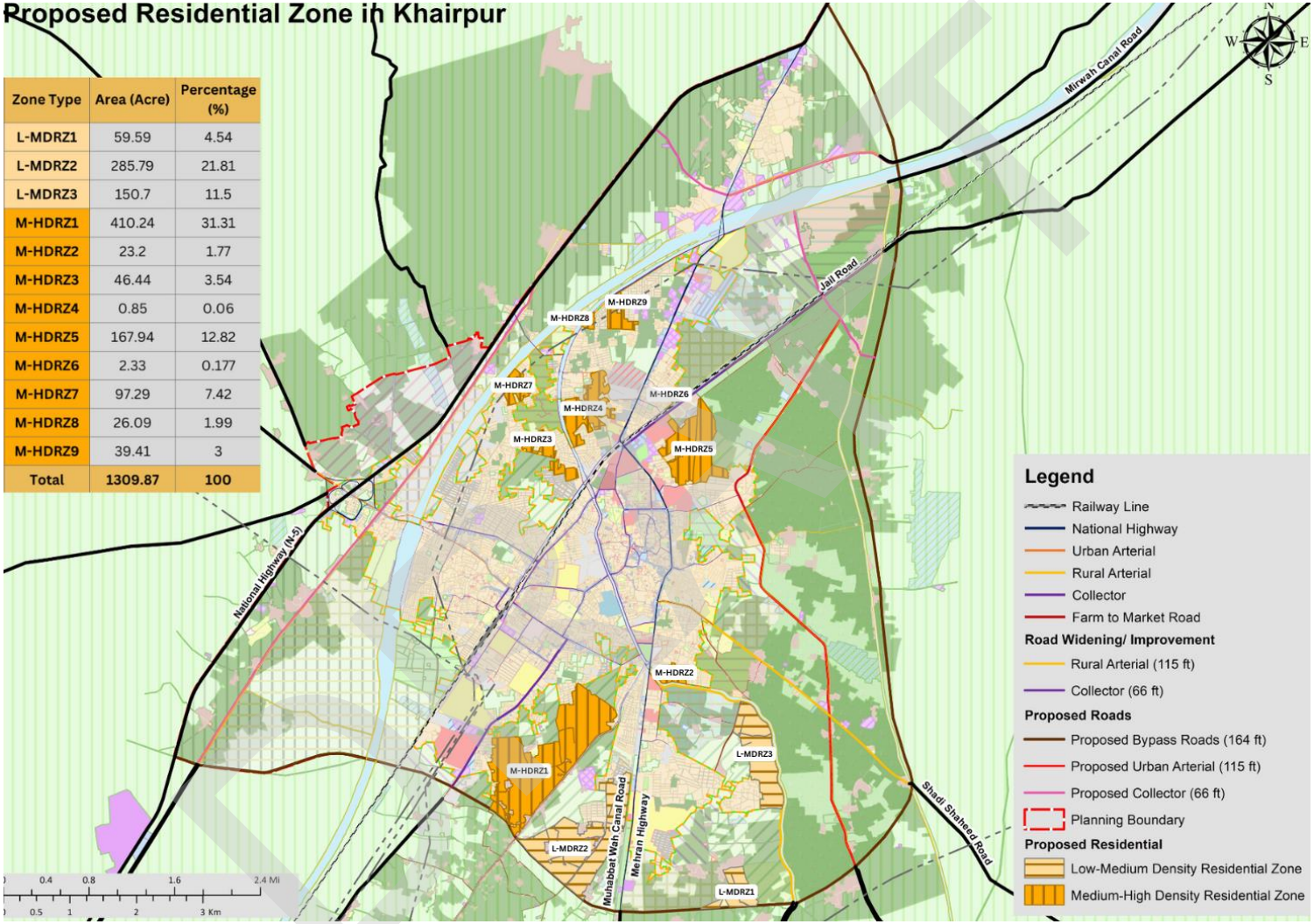


Figure 5-3, Proposed Residential Zones in Khairpur

Source: *The Consultant Team*

5.9 Priority Project

5.9.1 Development of a Site for Low-Income Communities in Khairpur City

A. Project Justification

Khairpur city is experiencing a growing housing shortage, with low-income groups being the most affected. A significant portion of residents live in substandard conditions, lacking basic infrastructure such as potable water, electricity, and sanitation. A socio-economic survey (2023) reveals that 78% of families own their homes, 22% rely on rented or government-subsidized housing. However, even among homeowners, many dwellings are unsafe and overcrowded due to financial constraints. Unplanned urban sprawl and encroachments have further exacerbated the issue, leading to environmental degradation and inefficient land use.

1. Site and Services Model

This project proposes the implementation of a "Site and Services Model", a sustainable, proven solution where the project authority provides developed plots equipped with essential infrastructure (roads, water, sanitation, and electricity) to beneficiary families. This model allows households to construct homes incrementally according to their financial capacity, ensuring affordability, reducing the proliferation of informal settlements, and promoting planned urban expansion. Building on the successful precedent of the Khuda-Ki-Basti (KKB) in cities like Karachi and Hyderabad, this project will leverage an established model to efficiently address Khairpur's housing deficit, benefiting approximately 3,500 plots in the short term while ensuring urban growth is inclusive and sustainable.

B. Project Scope

The scope is designed to create a holistic and sustainable neighbourhood rather than merely a collection of plots. This project aims to develop a planned community in Khairpur to address the housing crisis by:

- Developing a fully serviced site with core infrastructure including roads, potable water, sanitation, electricity, and waste management for a minimum of 3,500 plots.
- Allocating serviced plots with secure land tenure to pre-qualified low-income families, providing a legal and affordable foundation for housing.
- Integrating essential social infrastructure such as reserved land for a school, health clinic, green spaces, and community facilities to create a holistic community.

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- Implementing a progressive housing model by providing technical support and facilitating access to microfinance, enabling families to build their homes incrementally.
- Promoting sustainable urban growth by offering a planned alternative to slums, reducing informal settlements, and ensuring efficient land use.

C. Project Details

The project will cover a total site area of approximately 65 hectares, accommodating approx. 3,500 serviced plots, each measuring 120 square yards. The estimated development cost is PKR 25 million per hectare, amounting to a total project cost of approx. PKR 3 billion. The target beneficiaries are low-income families earning less than PKR 50,000 per month. The housing model consists of core housing system where the beneficiaries will acquire secure housing tenure and have access to serviced plot with core housing.

The site and service model emphasize incremental housing development. This approach is financially viable as it states working under core unit housing where basic services critical infrastructure including wall, sewerage, waste disposal point, kitchen, toilet and water connection will be provided to the beneficiaries.

Table 5-4, Cost Estimation for Low Income Housing

Cost Estimation for Development of a Low-Income Housing under Site and Service Model for Low-Income Communities in Khairpur City	
Land acquisition cost (per hectare)	19.76 million
Site development cost (per hectare)	25 million
Total Land Cost per Hectare	**44.76 million**
Cost for 65 Hectares (65 ha * 44.76 million)	2.91 billion
Miscellaneous (5% of Land and Development cost)	124.4 million
Total Cost	**3 billion**

Source: *The Consultant Team*

Facilities and Infrastructure

To create a sustainable and self-sufficient residential community, the project will incorporate several essential facilities and infrastructure.

Basic Utilities

The project will ensure a reliable piped water supply with a filtration plant, establish electricity infrastructure for a 24/7 power supply (integrating renewable energy where feasible), and implement a well-planned sewage and solid waste management system.

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Community Facilities

The proposed site will be equipped with educational institutions (primary and secondary schools), healthcare centres (clinics and dispensaries), and recreational spaces (parks, playgrounds, and green zones) to enhance the quality of life.

Commercial and Economic Activities

Designated retail and commercial areas will cater to daily needs, while small business zones will encourage entrepreneurship and create local employment opportunities for residents.

Transport and Road Network

The project will feature a network of paved, well-lit roads internally and improve public transport accessibility by establishing dedicated bus stops and enhancing linkages to major city routes.

D. Expected Benefits

The project will enhance the quality of life for low-income families. It will also help in the reduction of slum areas, leading to better urban management and increased security, fostering improved social cohesion. This approach will allow gradual improvement in housing quality through household-driven incremental development, enabling families to construct their homes step by step according to their financial capacity. The construction phase will generate employment opportunities, both directly and indirectly. Revenue will be generated through the sale and leasing of commercial plots.

Additionally, the planned commercial zones will lead to an increase in local economic activities. Proper land utilization will help reduce urban encroachments. The development of green spaces will enhance environmental sustainability, while the implementation of eco-friendly waste management and water conservation systems will contribute to a healthier urban environment.

E. Implementation Strategy

The project will be executed in a phased manner to ensure efficient development and timely completion.

Phase 1 (Year 1-2)

The initial phase will focus on land acquisition and legal formalities. Infrastructure development, including roads, utilities, and sewerage systems, will be carried out during this phase.

Phase 2 (Year 3)

The second phase will involve the demarcation and allocation of plots to beneficiaries followed by the construction of core housing components. Core housing will include construction of house wall and basic structures i.e.,

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washroom, kitchen and a roof structure within each unit. The overall construction should follow a planned pattern to make it cohesive to its surrounding and don't disturb the urban morphology of the area. In parallel, essential community facilities i.e. commercial spaces will also be allocated to encourage economic activities and make the site sustainable.

Phase 3 (Year 5)

In the final phase, progressive construction will begin depending upon household's financial capacities under site and service framework. Community services will be fully operationalized, and ongoing monitoring will ensure the sustainability of the project.

F. Implementing Authority

The project will be spearheaded by the Government of Sindh with District Administration Khairpur as lead implementing bodies. Municipal Committee Khairpur, Sindh Building Control Authority (SBCA) and other private contractors will provide technical support. Partnerships will be established with microfinance institutions to facilitate access to credit, enabling households to gradually build safe and durable homes on allocated serviced plots.

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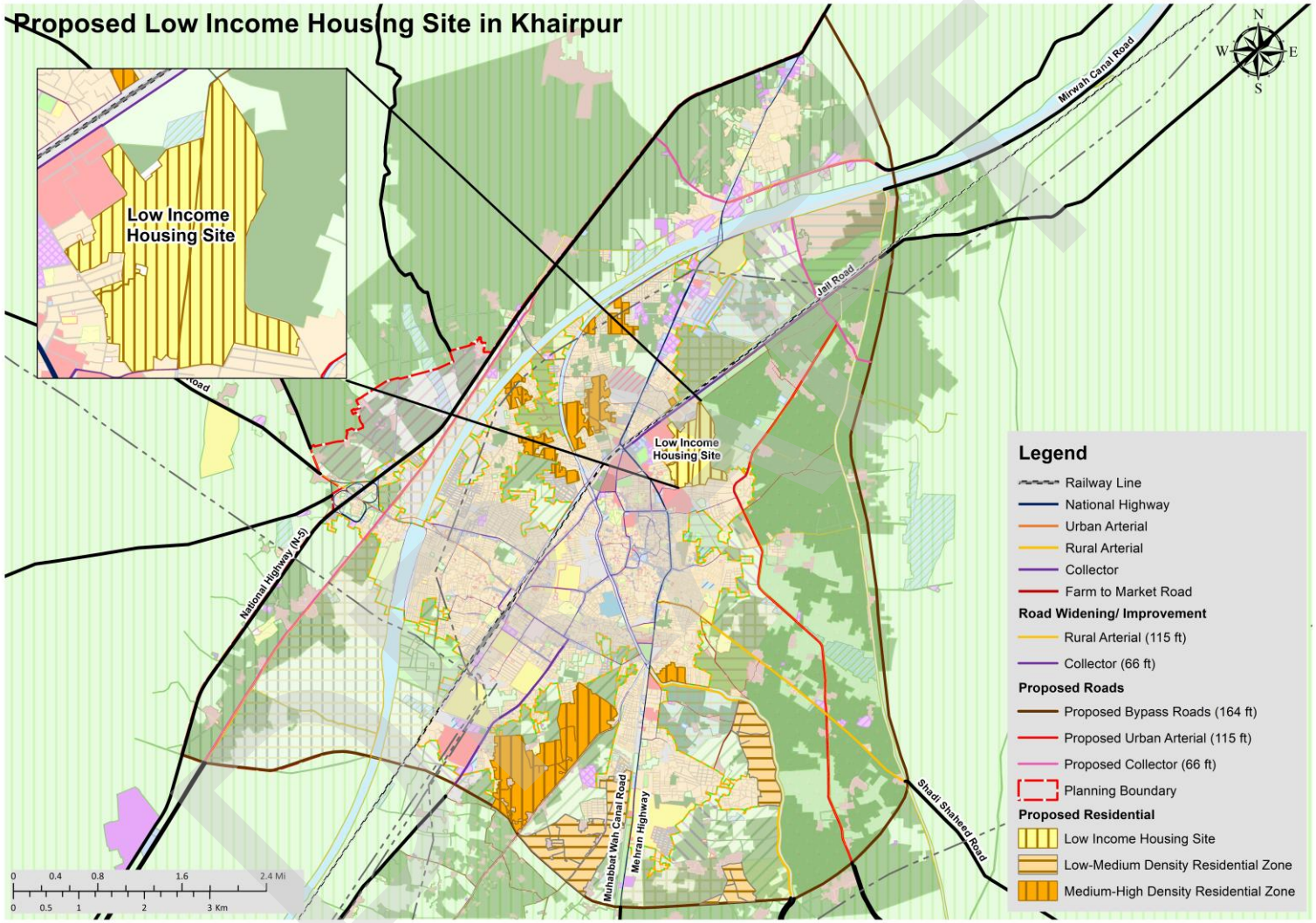


Figure 5-4, Proposed Low Income Housing Site in Khairpur

Source: *The Consultant Team*

5.10 Immediate Action Plan for Core Urban Area

To address Khairpur's urban challenges, the immediate action plan combines infill development for optimized land use and Katchi Abadi upgradation to improve living conditions.

5.10.1 Infill Development Strategy for Residential Areas

Objective: Maximize underutilized existing vacant spaces while preserving neighbourhood character.

- Identify vacant/underused plots in Khairpur's core using GIS mapping, prioritizing areas near existing infrastructure (e.g., roads, water lines).
- Adopt narrow lot housing models (80 sq yard) with lane access, to increase density without compromising walkability.
- Launch infill project with mixed housing (e.g., low-rise apartments) in collaboration with private developers, ensuring 30% affordability quotas.
- Conduct design charrettes with residents to address concerns about parking, heritage, and traffic key issues flagged in Saskatoon's infill program[11].

5.10.2 Katchi Abadi Upgradation Strategy

Objective: Transform Katchi Abadis into liveable and secure communities.

To address the pressing need for sustainable urban development in Khairpur, the following model prioritizes community-centric, low-cost solutions tailored to the city's unique challenges-particularly for notified Katchi Abadis like Shaheed Abad, Banarsi and Madina colony or etc. This approach balance in-situ improvements with structured relocation, ensuring affordability, tenure security, and climate resilience while leveraging local resources and policies.

A. In-Situ Upgradation Model for Katchi Abadi

Khairpur's notified Katchi Abadi, Shaheed Abad, Banarsi and Madina colony or etc., suffers from overcrowding, inadequate sanitation, and tenure insecurity despite being legally recognized. This model focuses on improving living conditions without relocating residents, aligning with the Sindh Katchi Abadis Act (1987).

Key Interventions includes:

[11] *https://www.saskatoon.ca/business-development/development-regulation/developers-homebuilders/neighbourhood-infill-development*

- Expedite the formalization of tenure through property deeds for households that existed before 1987, using GIS mapping (to resolve disputes).
- Housing Resilience:
  - Raised plinths using local bricks to combat flooding.
  - Incremental loans (via Khushhali Bank) for home upgrades.
- Core Infrastructure:
  - Install community-managed RO plants (addressing Khairpur's saline groundwater).
  - Replace open drains with covered sewers linked to municipal systems.
  - Paved pathways with permeable materials (e.g., interlocking bricks) to reduce flooding.
  - Slope-Adjusted drainage channels to prevent water stagnation.
  - Plant native, flood-resistant vegetation along drainage lines.
  - Skills training (masonry, plumbing) to enable local labor employment in upgradation projects.

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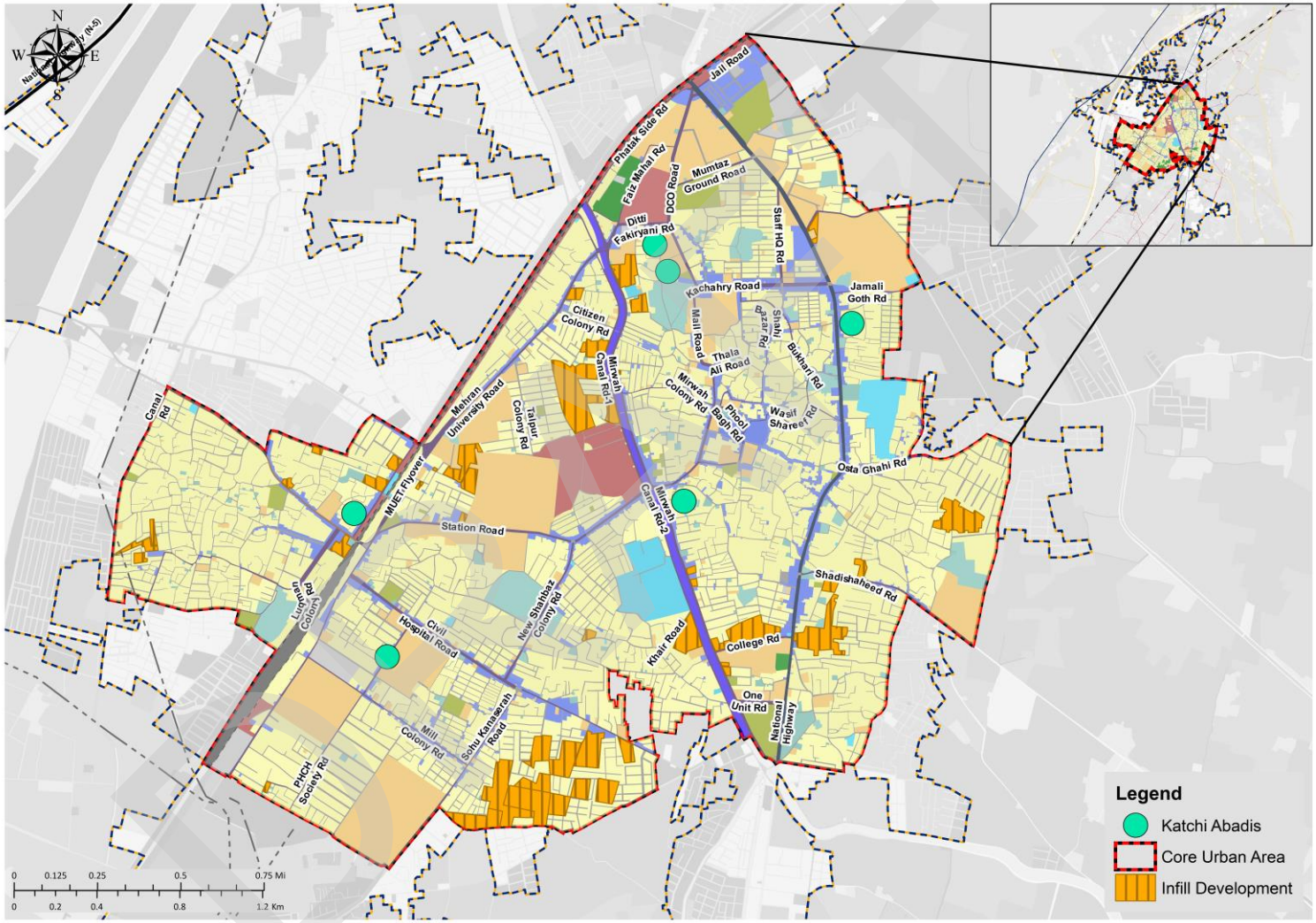


Figure 5-5, Priority Areas for Residential Development - Khairpur

Source: *The Consultant Team*

SECTION - 6: SOCIAL INFRASTRUCTURE

6.1 Introduction

This section outlines a strategic framework for enhancing social infrastructure, starting with an assessment of the existing situation. It includes a SWOT analysis to evaluate strengths, weaknesses, opportunities, and threats, followed by a need assessment using demand projections and Land Suitability Analysis (LSA). Based on these findings, policy guidelines and a Strategic Development Plan are proposed to address gaps and ensure sustainable growth. Additionally, priority projects and an Immediate Action Plan (IAP) for the core urban area are detailed to tackle urgent needs and improve social infrastructure access and quality.

6.2 Education

6.2.1 Existing Situation

A. District Level Educational Facilities

District Khairpur possesses 8th rank in terms of literacy rate among the districts of Sindh province. The education sector boasts an extensive network of schools spanning across the entire district Khairpur; however, the quality of education and inclusivity is compromising. This network comprises approximately 3,617 schools, encompassing Primary, Middle, Secondary, and Higher Secondary Government schools. Among these, 471 are exclusively for boys, 483 for girls, and 2,663 are mixed-gender schools. Additionally, there exist private sector schools operating under government registration. The male literacy rate (aged 15-49 years) in Khairpur stands at 60.0%, while the female literacy rate is recorded at 35.5%. The **Table** 6-1 illustrates the distribution of schools based on their respective levels.

Table 6-1, Number of Schools in Khairpur District

Level	Total	Male	Female	Mixed
Primary	3,266	432	390	2,444
Middle	78	8	31	39
Elementary	125	9	30	86
Secondary	126	16	30	80
High. Sec	22	6	2	14
Grand Total	**3,617**	**471**	**483**	**2,663**

Source: *RSU -Sindh Education Management Information System (SEMIS) 2018-2019*

In Khairpur district, there exists a significant gap in enrolment rates between boys and girls, with boys constituting 61.9% of the total enrolment, while girls only make up 38.1%. This stark contrast in enrolment figures warrants a closer examination of the underlying causes and reasons contributing to this

disparity. One primary factor contributing to the enrolment gap is deeply rooted socio-cultural norms and traditions that prioritize boys' education over girls. In some areas of Khairpur district, the lack of accessible educational infrastructure, particularly for girls, acts as a significant barrier to enrolment.

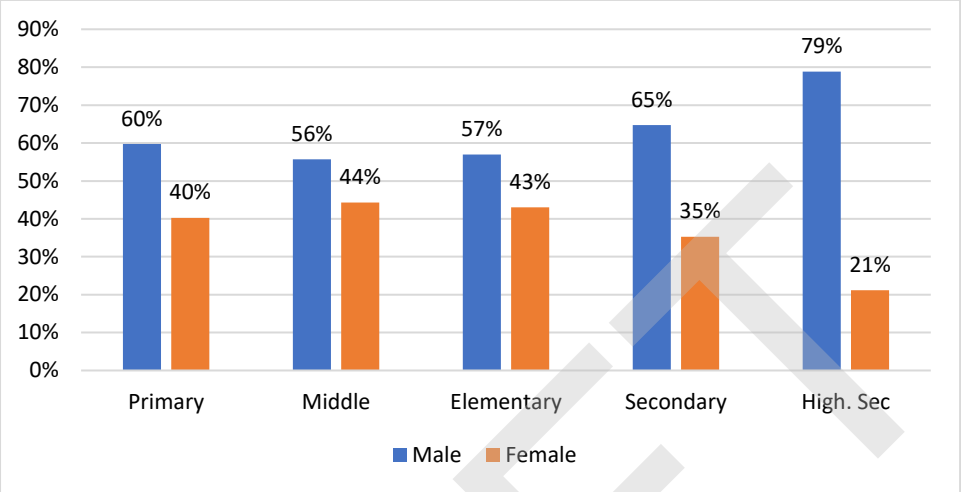


Figure 6-1, depicts enrolment rate of students respective to education level.

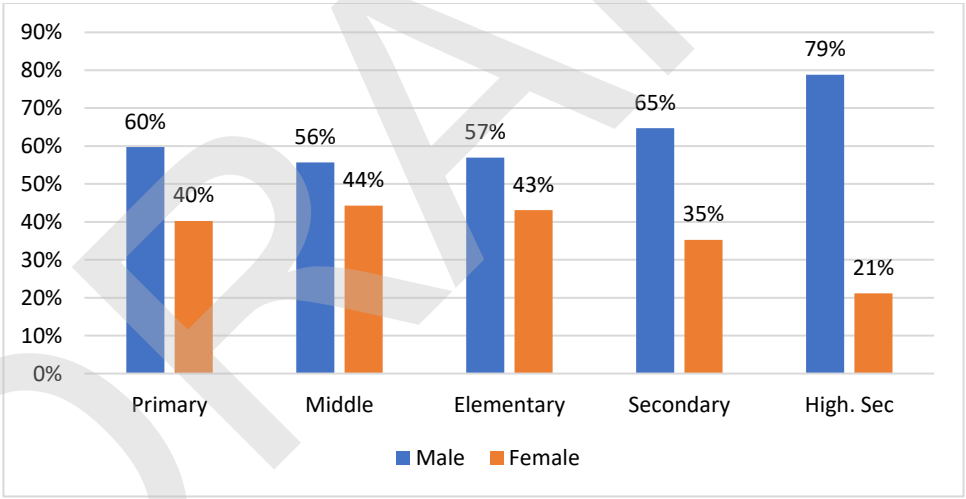


Figure 6-1, Enrolment Rate of Students in Schools

Source: *RSU -Sindh Education Management Information System (SEMIS) 2018-2019*

The student-teacher ratio in Khairpur district, as derived from current data, stands at approximately 38.7 students per teacher. With a total of 9,051 teachers catering to an enrolment of 350,611 students, this ratio reflects the distribution of educational resources within the district. Analysing this figure sheds light on the classroom dynamics and the challenges educators might face in ensuring personalized attention and quality instruction for each student. A student-teacher ratio of 39 indicates a considerable workload for teachers, potentially impacting their ability to provide individualized support and feedback to students. Moreover, it underscores the importance of effective classroom management strategies and academic approaches that can accommodate diverse learning needs within larger class sizes.

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In Khairpur district, the educational landscape is characterized by a significant student-to-classroom ratio, indicative of both the challenges and opportunities within the local educational system. With a total student population reaching 350,611 individuals and only 8,064 classrooms available. A ratio of 44 students per classroom suggests that classrooms are often crowded, potentially limiting individualized attention, and inhibiting interactive learning experiences.

Colleges in Khairpur district are contributing their efforts to increase the educational level in this area by offering demanding courses and programs. Among the list there are 21 non- professional colleges and 5 professional colleges in the district. The **Figure** 6-2 below illustrates the overall enrolment rate of students in colleges.

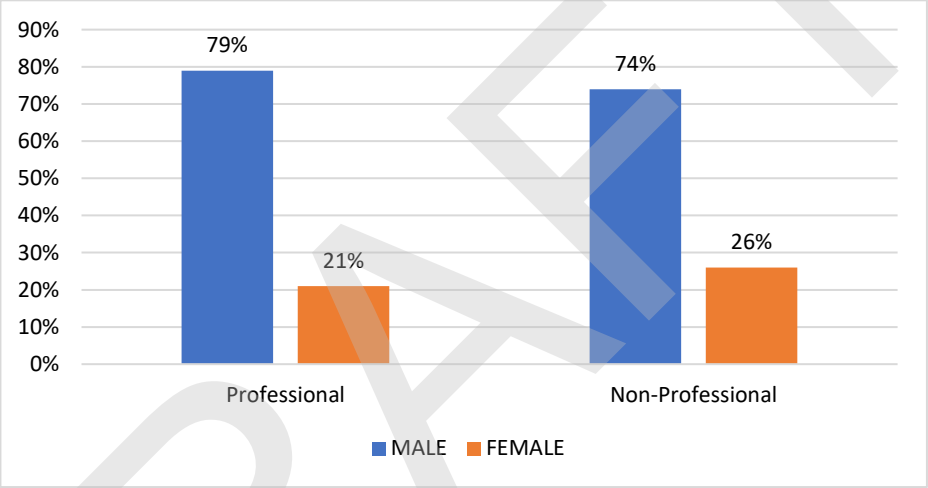


Figure 6-2, Enrolment Rate of Students in Colleges

Source: *RSU -Sindh Education Management Information System (SEMIS) 2018-2019*

The primary emphasis of vocational education lies in developing technical skills rather than focusing solely on academic knowledge. Across the province, there exists a network of vocational institutions, ranging from polytechnics to monotechnic and commercial education centres, encompassing both governmental and private sectors. The Government of Sindh is deeply invested in skill development programs targeted specifically towards youth aged 18 to 35. In the district there are a total of 5 vocational institutes. Details of technical institutes are depicting below in the table.

Table 6-2, Enrolment in Technical Institutes Khairpur District

Technical Institutes	Total	Male	Female
Polytechnic Institutions	1	1	-
Monotechnic Institutions	2	2	-
Commercial Institutions	3	3	-
Vocational Institutions and Vocational Schools	5	-	5

Source: *RSU -Sindh Education Management Information System (SEMIS) 2018-2019*

B. City Level Education Facilities

The education status is average in Khairpur city. According to 2017 census, the overall literacy rate of the city is 68%; for males it is 76% and for females it is 59% as shown in the **Table** 6-3.

Table 6-3, Educational Attainment Level in Khairpur City

Education Level	Male (%)	Female (%)
Primary but Below Matric	19	17
Matric but Below Degree and Other	18	14
Degree and above	13	7

Source: *Pakistan Bureau of Statistics, 2017**

**2017 census data for literacy rate is utilized because the 2023 census data for literacy rate in urban localities is not yet available.*

The **Table** 6-3 above illustrates the educational attainment levels within the population of Khairpur city. It is evident that a small proportion of both male and female residents have achieved educational qualification. As the educational level increase the percentage decrease for both male and female.

According to the socio-economic survey 2023, almost 48% of the households in the city can access and afford up to secondary level educational facilities. Although, it can be seen in the **Figure** 6-3 that the major issue is accessibility besides affordability. While only few households can't afford and access education at all. The different categories of the educational facilities with respect to their accessibility and affordability.

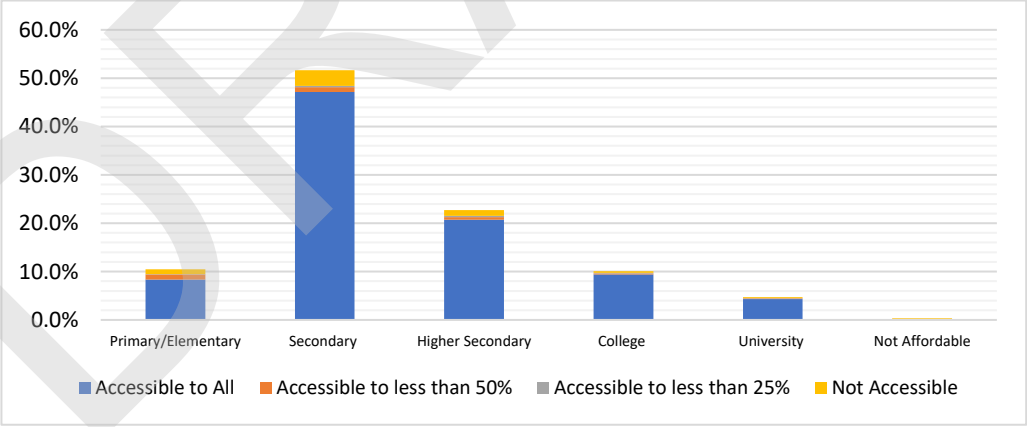


Figure 6-3, Correlation between Affordability and Accessibility to Educational Facilities

Source: *The Consultant Team*

From the secondary data average student-teacher ratio and student-classroom ratio for Khairpur city has been analysed which is shown in the **Table** 6-4. Average student-teacher ratio of Khairpur city comes out to be comparable to UNESCO standards which suggests the average student-teacher ratio 40:1 in primary education and 35:1 (2014 estimates) in secondary education – far higher than the global average of 18:1.

Table 6-4, Average Student Teacher and Student Classroom Ratio of Khairpur City

Educational Facilities	Average Student Teacher Ratio	Average Student Classroom Ratio
Primary/Elementary School	27:1	49:1
Middle School	6:1	6:1
Secondary School	25:1	39:1
Higher Secondary School	24:1	56:1

Source: *GIS MAP | RSU | School Education and Literacy Department*[12]

According to the land use survey 2023, at present there are 40 primary/elementary schools operating in the city. 8 higher secondary schools are currently running. Similarly, the number of colleges and universities are 2 and 5 respectively as shown in the **Table** 6-5 and their spatial distribution is shown in the **Figure** 6-4**.**

The city has a prestigious high order educational facility, but primary and secondary schools lag behind; there is a significant need for secondary schools. Basic education level services are lacking here, while the city caters to the entire country with national level prestigious institutes like Mehran University of Engineering and Technology (MUET) and Shah Abdul Latif University.

Table 6-5, Number of Educational Facilities in Khairpur City

Sr. No.	Educational Facilities	Count
1	Elementary/Primary School	57
2	High School	30
3	Higher Secondary School	8
4	Private Institutes	78
5	College	6
6	University	5
7	Library	1
8	Vocational Training Institutes	4

Source: *The Consultant Team*

Education facilities' proximity is a critical factor in ensuring accessible and quality education for students. To assess the proximity of educational institutions NRM and planning standards stipulate a minimum distance of 500 meters for primary schools, 1.5 km for middle school and 5 kilometres for higher secondary schools. Proximity is especially important in urban areas like Khairpur city, where population density can impact accessibility. As shown in the **Figure** 6-4 below that the primary school in Khairpur city plays a crucial role in providing foundational education to various neighbourhoods.

[12] https://rsu-sindh.gov.pk/programs/onlineGIS.php?district=Khairpur%20Mirs

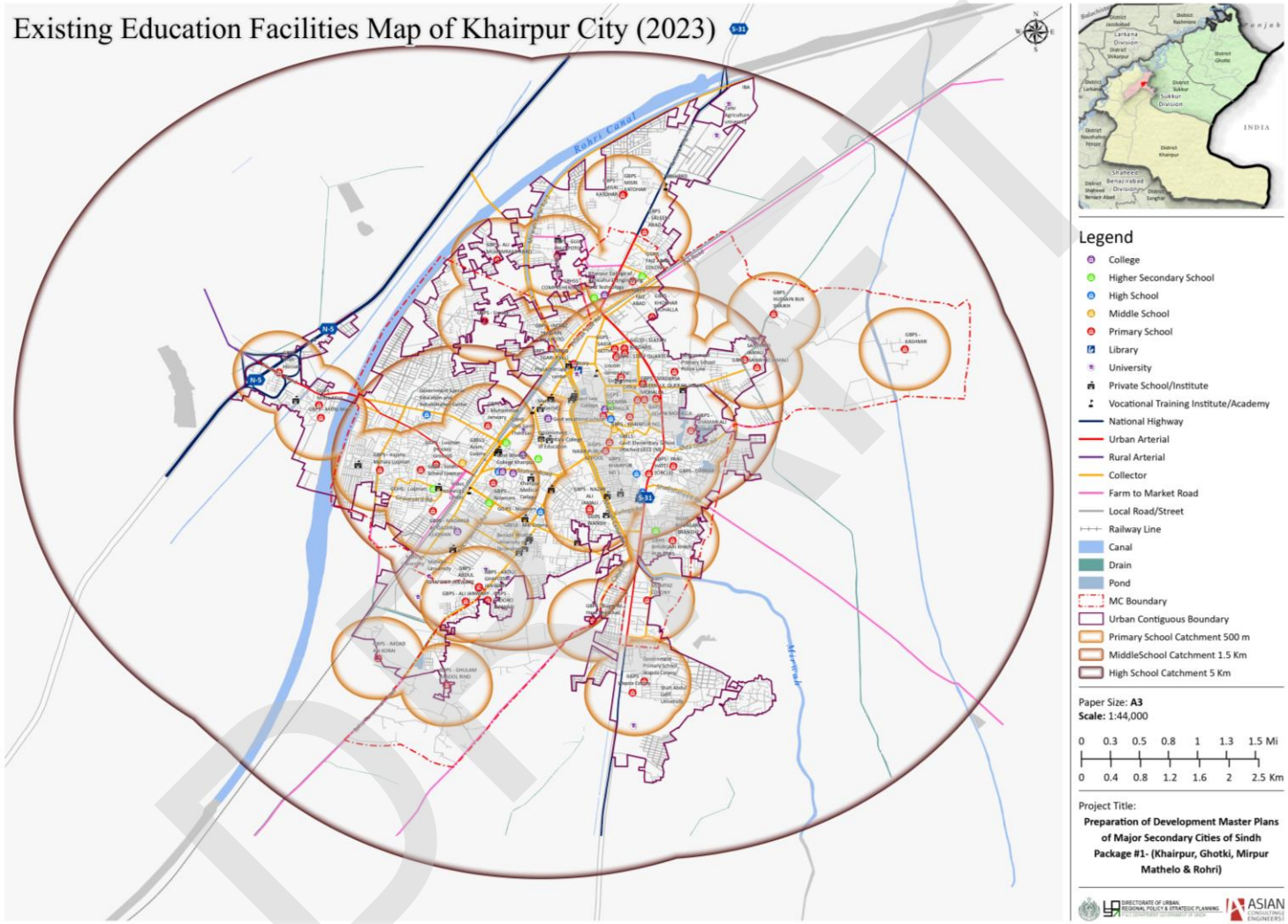


Figure 6-4, Existing Education Facilities Map of Khairpur City

Source: *The Consultant Team*

The city faces a significant gap in the primary and middle education sector which don't serves some parts of the city. There is total 8 higher secondary schools including public and private, these institutions serve not only the students of Khairpur but also those from neighbouring areas. Addressing this gap through the establishment of a dedicated primary school or by expanding existing middle and secondary institutions are essential to ensure that the youth of Khairpur receive the education they deserve and contribute to the city's growth and development.

6.2.2 SWOT Analysis

Strengths	Weaknesses
• Hierarchy of education institution exist. • There exists large number of private sector educational institutes as well.	• No quality check and maintenance of infrastructure. • Institution to meet the demand of skilled labour are missing.
Opportunities	**Threats**
• Develop vocational training and skill development programs that align with local job market needs, enhancing employability for graduates. • The rise of digital education tools presents an opportunity to improve learning experiences.	• Policy issues • Poverty and unemployment. • Economic downturns may lead to budget cuts in public education funding.

6.2.3 Need Assessment

The student-teacher ratio in primary schools (27:1) and student-classroom ratio remains significantly high (49:1) as per UNESCO standard, leading to overcrowded classrooms that hinder personalized attention and interactive learning. While the city hosts a reasonable number of higher education institutions, a shortage of primary and middle schools creates an imbalance in the educational infrastructure. Although prestigious national-level institutions serve a broader population, the need for accessible basic education within the city remains unfulfilled.

Proximity to educational facilities is another key concern. While densely populated areas like Phatak Colony and Faizabad Colony have access to primary schools, while Mohallah Burghari and its vicinity areas face educational gaps due to their distance from existing institutions. Some of the key educational needs for the city are follow below:

- Targeted interventions are essential to bridge the gender gap in literacy rates.
- Efforts should focus on improving the availability and affordability of higher education.

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- Investment in school infrastructure is crucial to lower student-classroom ratios and enhance learning conditions.
- Addressing the shortage of primary and middle schools will help create a more equitable education system.
- Ensuring all areas, particularly underserved neighbourhoods, have adequate access to primary education facilities.
- Implementing financial aid programs can alleviate affordability barriers and promote equitable access to education.

A. Land Suitability Analysis of Education

Land suitability analysis (LSA) for educational facilities in Khairpur city (**Figure** 6-5) is crucial in determining the best locations for schools, particularly emphasizing areas that are easily accessible and strategically positioned. Suitable sites are often found along main roads such as National Highway and Jail Road, which enhance accessibility for students and facilitate transportation options such as school buses, bicycles, and pedestrian access. Proximity to existing residential neighbourhoods/ settlements is also important, as it ensures that schools are within a reasonable distance for families, ideally within 500 meters to encourage walking and reduce traffic congestion. Existing educational facilities within 500 meters are constraints, indicating saturation in those zones. Meanwhile, locations further than this distance are more favourable. Proximity to parks and open spaces enhances the suitability of sites, making them more attractive for educational purposes. Additionally, the analysis considers environmental factors, ensuring that schools are not located near hazardous land uses like industrial areas that could pose health risks to students. Overall, effective land suitability analysis helps identify optimal locations for educational facilities that promote safety, accessibility, and community integration.

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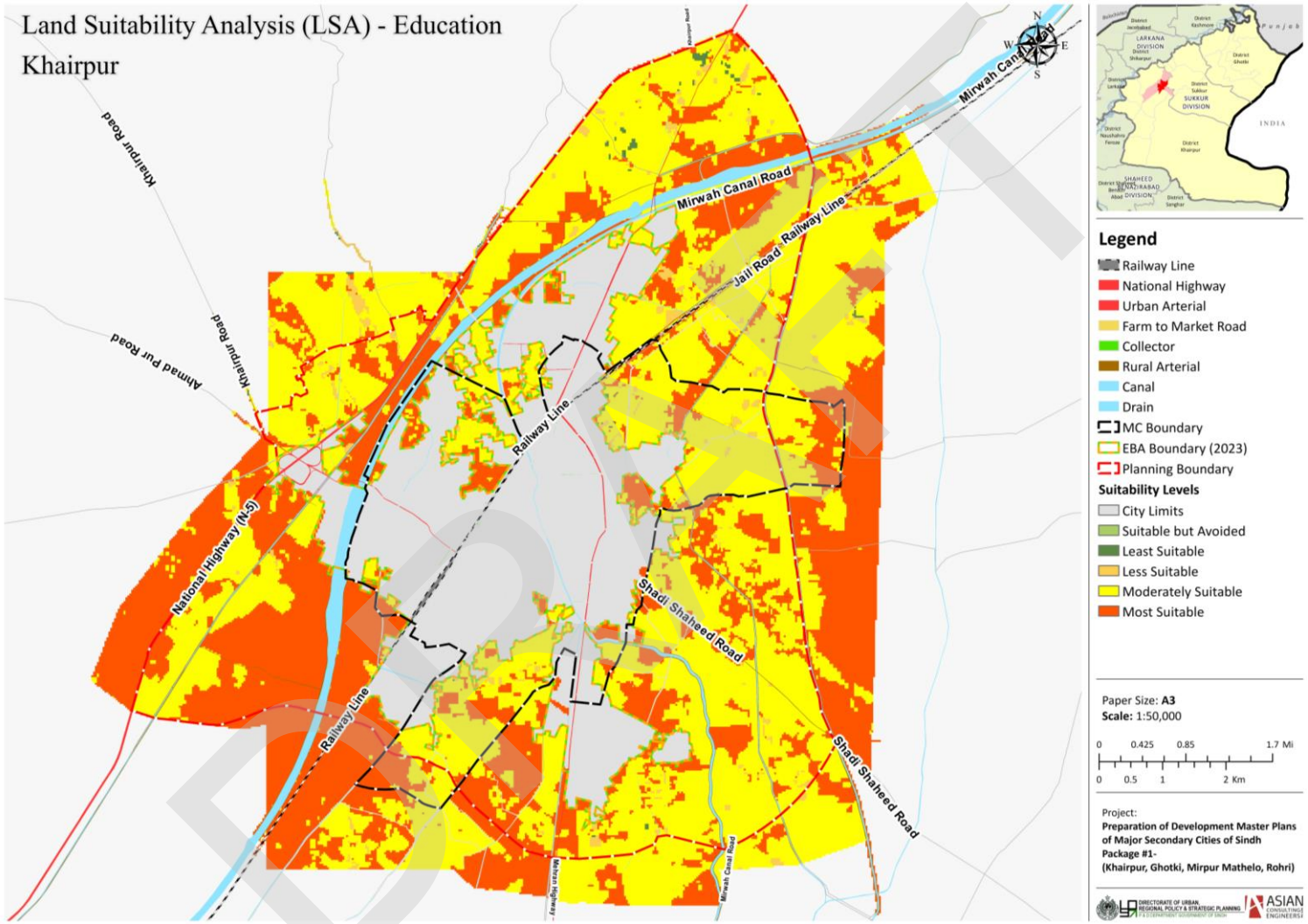


Figure 6-5, Land Suitability Analysis - Education

Source: *The Consultant Team*

6.2.4 Policy Guidelines

The education sector in Khairpur city must be developed in alignment with existing laws, policies, rules, and regulations at the federal, provincial, and local levels. The following policy guidelines are framed with respect to the available legal framework to ensure effective implementation and compliance.

A. Policy Measures for Infrastructure Development

Construction and Upgradation of Schools

Under the Sindh Right to Free and Compulsory Education Act (2013), the provincial and local authorities shall prioritize the construction and upgradation of schools in Khairpur District, ensuring that all schools have adequate classrooms, furniture, and basic facilities such as clean water, sanitation, and electricity.

Disaster-Resilient School Buildings

In compliance with the Sindh Building Control Ordinance (1979) and National Disaster Management Authority (NDMA) Guidelines, all new school buildings shall be constructed using disaster-resilient designs, especially in flood-prone areas. Existing schools in hazardous zones shall be retrofitted to withstand natural disasters.

B. Policy Measures for Access to Education

Enrolment Drives

Under the Sindh Right to Free and Compulsory Education Act (2013), enrolment drives shall be conducted to ensure that all children aged 5 – 16 years are enrolled in schools. Special attention shall be given to marginalized communities, including girls, children with disabilities, and those from low-income families.

C. Policy Measures for Quality Education

Teacher Training and Recruitment

Under the Sindh Teachers Education Development Authority Act (2014), a comprehensive teacher training program shall be implemented to improve the quality of teaching. Vacant teaching positions shall be filled through transparent recruitment processes, ensuring that only qualified and trained teachers are hired.

Curriculum Reforms

The Sindh Curriculum Framework shall be revised to align with modern educational standards and local needs. Emphasis shall be placed on STEM (Science, Technology, Engineering, and Mathematics) education, digital literacy, and vocational training to prepare students for future challenges.

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D. Policy Measures for Inclusive Education

Special Education Programs

Under the Sindh Empowerment of Persons with Disabilities Act (2018), special education programs shall be introduced to cater to the needs of children with disabilities. Schools shall be equipped with assistive technologies and trained staff to provide inclusive education.

Girls' Education

To promote girls' education, the Sindh Right to Free and Compulsory Education Act (2013) shall be enforced to ensure that all girls have access to quality education. Scholarships and stipends shall be provided to girls from low-income families to encourage enrolment and retention.

E. Policy Measures for Community Participation

Parent-Teacher Associations (PTAs)

Under the Sindh Local Government Act (2013), Parent-Teacher Associations (PTAs) shall be established in all schools to foster community involvement in education. PTAs shall play an active role in monitoring school performance, addressing grievances, and supporting school improvement initiatives.

Awareness Campaigns

Awareness campaigns shall be conducted under the Sindh Transparency and Right to Information Act (2016) to educate parents and communities about the importance of education and their rights under the law.

F. Policy Measures for Vocational and Technical Education

Skill Development Programs

Under the Sindh Technical Education and Vocational Training Authority (STEVTA) Act (2012), vocational and technical education programs shall be introduced in Khairpur District. These programs shall focus on skill development and job readiness, providing students with opportunities for gainful employment.

Partnerships with Industry

Partnerships with local industries and businesses shall be established to provide internships, apprenticeships, and job placements for students. This will ensure that vocational training programs are aligned with market needs.

G. Policy Measures for Digital Education

E-Learning Platforms

Under the Sindh ICT Education Policy, e-learning platforms shall be introduced to provide students with access to digital resources and online learning opportunities. Schools shall be equipped with computers, internet connectivity, and digital tools to facilitate blended learning.

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Teacher Training in ICT

Teachers shall be trained in information and communication technology (ICT) to effectively integrate digital tools into their teaching practices. This will enhance the quality of education and prepare students for the digital age.

H. Policy Measures for Monitoring and Evaluation

Regular Inspections

Under the Sindh Education Management Information System (SEMIS), regular inspections shall be conducted to monitor school performance, infrastructure, and compliance with educational standards. Inspection reports shall be made publicly available to ensure transparency.

Performance Metrics

Performance metrics shall be developed to evaluate the effectiveness of educational policies and programs. Data-driven improvements shall be made to address gaps and ensure continuous progress.

Feedback Mechanisms

Feedback mechanisms shall be established to gather input from students, parents, teachers, and community members. This feedback shall be used to make necessary adjustments to educational policies and practices.

6.2.5 Strategic Development Plan

Khairpur city faces educational challenges such as inadequate schools, poor infrastructure, untrained teachers, and an outdated curriculum. Strengthening education through reforms, better facilities, and capacity-building is essential. Key improvements include enhancing teaching methods, merit-based teacher recruitment, accountability, and student-centred learning. Governance can be improved through standard-setting, IT-based accountability, school consolidation, public-private partnerships, and stronger district management. Equitable resource allocation and fiscal sustainability will ensure transparency and accountability, fostering long-term educational progress.

A. Long-Term Plan

- Construct new secondary and higher secondary schools in underserved areas (e.g., Mohallah Burghari, Phatak Colony) to reduce overcrowding and improve accessibility.
- Upgrade existing schools with climate-resilient designs (flood-resistant structures, solar-powered classrooms) and digital smart labs for STEM education.
- Establish a Technical and Vocational Education Hub near Khairpur's industrial zones (e.g., along National Highway) to align education with job market demands (e.g., agriculture, etc.).

- Revise textbooks to incorporate 21st-century skills (digital literacy, critical thinking) and local relevance (Sindhi culture, agro-based economy).
- Introduce vocational training programs in collaboration with Shah Abdul Latif University (SALU) and MUET, focusing on:
  - Agricultural technology (Khairpur's date farming industry).
  - Textile and handicraft skills (linked to local artisan communities).
  - Basic IT and coding for youth employability.
- Launch girls' education incentive programs (stipends, free textbooks, safe transport) to improve female enrolment (currently 38.1% vs. male 61.9%).
- Partner with Sindh Education Foundation (SEF) and NGOs to establish e-learning centers in marginalized areas.

B. Short-Term Plan

- Rehabilitate 18 priority schools (e.g., GBPS - Staff Quarter, GBPS Mill Colony) with:
  - RO water plants and separate toilets for girls/boys.
  - Boundary walls for safety and playgrounds for physical activity.
  - Furniture and classroom repairs to reduce overcrowding (current 49:1 student-classroom ratio).
- Monthly teacher workshops on modern pedagogies (activity-based learning, child psychology).
- Biometric attendance systems for teachers and students to curb absenteeism.
- Strengthen Parent-Teacher Councils (PTCs) for transparent school management.
- Public dashboards at Municipal Committee office to track school progress (funding, enrolment, exam results).
- Merit-based teacher recruitment to fill vacancies (especially in science/math).
- Provide tablets/TVs with preloaded Taleemabad lessons for primary schools.
- Radio-based education programs for remote areas with limited internet.

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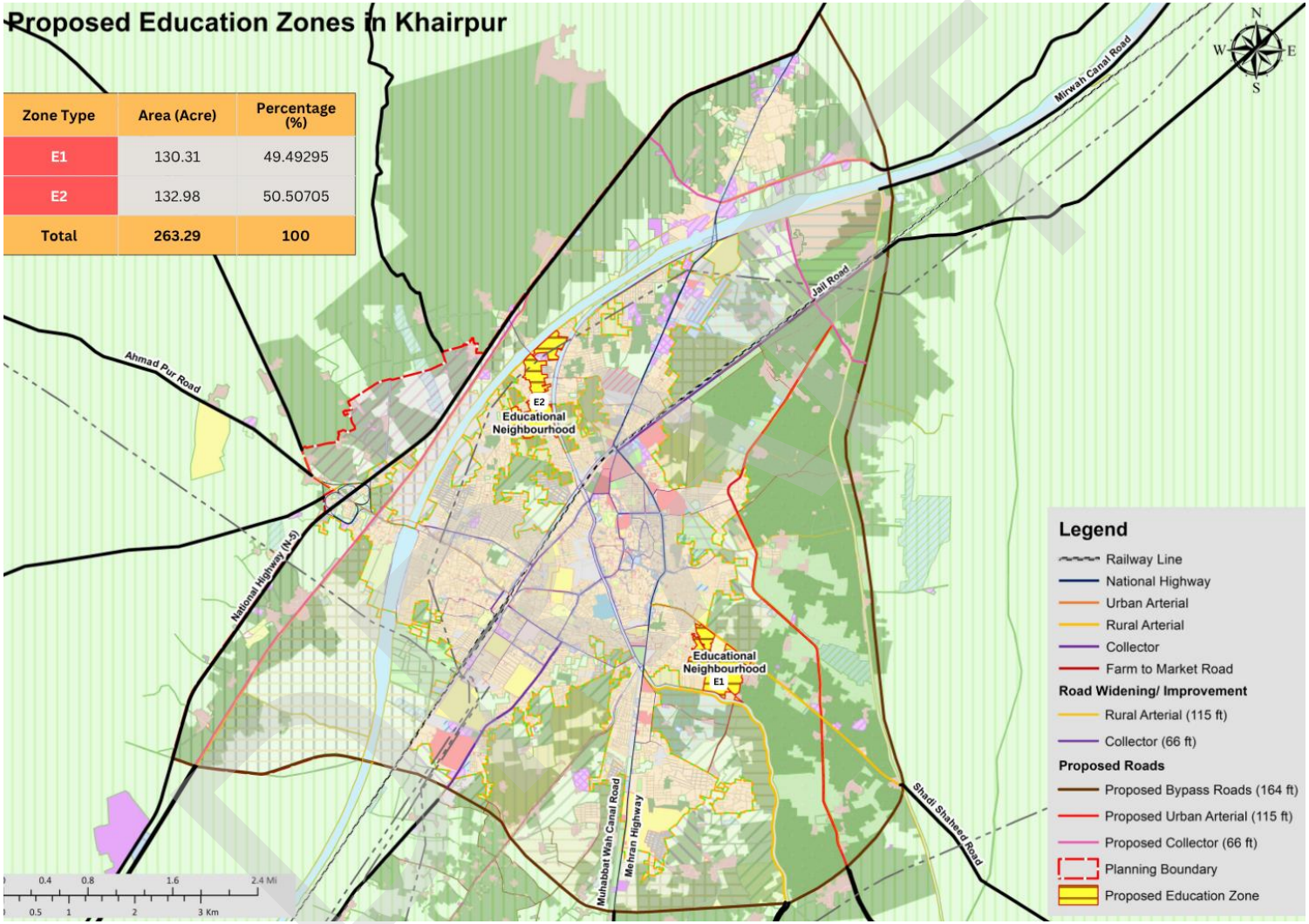


Figure 6-6, Proposed Education Zones in Khairpur

Source: *The Consultant Team*

6.2.6 Priority Projects

Education is the cornerstone of any prosperous urban strategy. In Khairpur city, the current state of primary and secondary education infrastructure is suboptimal, with many schools lacking essential facilities such as clean water, electricity, functional toilets, and playgrounds. This not only hampers the quality of education but also discourages enrollment, particularly among girls and marginalized communities. To address these challenges, priority projects will focus on the repair, rehabilitation, and upgrading of existing schools, ensuring they meet modern educational standards and provide a safe, inclusive, and conducive learning environment for all students.

A. Repair, Rehabilitation, and Upgradation of Schools with Allied Infrastructure (Excluding IAP projects)

1. Project Justification

The education sector in Khairpur city is in urgent need of intervention. The dilapidated and unsafe conditions of government schools pose a critical barrier to education, resulting in low enrollment, high absenteeism, and elevated dropout rates. Many schools lack basic amenities like clean water, functional toilets, and reliable electricity, creating an environment that is not conducive to learning.

This project is essential for providing a safe, functional, and inclusive learning environment that protects students, motivates attendance, and ensures equitable access to quality education for all children, including those with disabilities.

2. Project Scope

This project will involve the comprehensive repair, rehabilitation, and upgrading of identified school buildings and their surroundings. The detailed scope of works includes:

- Execute comprehensive structural repairs, including roof replacement, plastering, repainting, and the installation of new floors, doors, and windows to ensure building safety and functionality.
- Provide essential utilities by installing solar-powered electrical systems, water filtration plants, and new blocks of gender-segregated toilets with running water in each school.
- Enhance the learning environment through the modernization of classrooms with new furniture and smart boards, and the establishment of dedicated computer and science laboratories.
- Ensure student safety and inclusion by constructing secure boundary walls, developing playgrounds, and installing wheelchair ramps and disabled-friendly toilets for full accessibility.

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The following schools have been identified as priority institutions for immediate intervention based on their current condition and the number of students they serve:

Sr. No.	Institute Name	Institute Hierarchy	Area (Ha)
1	Govt. Boys Primary School - Ali Janwary	Government Higher Secondary School	0.05
2	Govt. Boys Primary School - Saleem Abad	Government Higher Secondary School	0.13
3	Govt. Boys Primary School - Mumtaz Colony	Government Higher Secondary School	0.32
4	Govt. Girls High School - Faiz Abad Colony	Government Higher Secondary School	0.30
Total Area			**0.80**

3. Project Benefits

- **Enhanced Learning Environment:** Improved infrastructure will create a safe, comfortable, and stimulating environment for students, fostering better academic performance.
- **Increased Enrolment:** The provision of basic facilities and upgraded infrastructure will attract more students, particularly girls, reducing the gender gap in education.
- **Improved Literacy Rate:** By addressing the current deficiencies in school infrastructure, the project will contribute to raising literacy rates in Khairpur city.
- **Community Empowerment:** Better educational facilities will uplift the socio-economic status of the community, enabling families to break the cycle of poverty.
- **Inclusive Education:** Upgraded facilities will ensure accessibility for students with disabilities, promoting inclusivity and equal opportunities for all.

4. Implementation Strategy

Phase 1: Assessment and Planning

- Conduct a detailed assessment of the selected schools to identify specific needs.
- Develop a comprehensive rehabilitation plan, including cost estimates and timelines.

Phase 2: Infrastructure Development

- Repair and rehabilitate school buildings, ensuring structural safety and functionality.

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- Install basic facilities such as water supply systems, electricity, and gender-segregated toilets.
- Construct playgrounds and boundary walls to ensure safety and recreational opportunities.

Phase 3: Capacity Building

- Train teachers and staff on maintaining the new facilities and creating an inclusive learning environment.
- Engage the community to foster ownership and ensure the sustainability of the project.

Phase 4: Monitoring and Evaluation

- Establish a monitoring mechanism to track progress and ensure quality standards.
- Conduct regular evaluations to assess the impact of the project on student enrollment and performance.

5. Implementing Authority

- District Education Works and Services Department, Government of Sindh
- Collaborating Partners: Local NGOs, community organizations, and private sector stakeholders.

6. Estimated Cost

Total Estimated Cost: Rs. 822.02 million (approx.)

6.2.7 Immediate Action Plan for Core Urban Area

A. Repair, Rehabilitation, and Provision of Missing Facilities to School Buildings

The core urban area of Khairpur city is home to several government schools that are in dire need of repair and rehabilitation. Many of these schools lack basic facilities such as clean water, electricity, functional toilets, and safe infrastructure, which severely impacts the quality of education and student enrolment. This immediate action plan focuses on addressing these critical gaps by repairing and rehabilitating school buildings, providing missing facilities, and ensuring a safe and conducive learning environment for all students.

The following schools in the core urban area have been prioritized for immediate intervention:

- GBELS - Azam Colony
- GBELS - Govt. Elementary School attached GECE (M)
- GBELS - Mill Colony
- GBHS - Bhurgari Khairpur Mirs

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- GBPS - Shaman Ali Shaikh
- GBPS - Luqman
- GBPS - Staff Quarter
- GBPS - Suming (Gari-Pull)
- GBPS - Khairpur No.1
- GBPS - Khairpur No.2
- GGPS - Jillani Mohalla
- GGPS - Luqman (Hockey Ground)
- GGPS - Saida Goth
- GGLSS - Sultan Madaris
- GBHS - Ghs. Saint Theresas
- GGHS - Luqman
- GGHS - Nizamani
- GGHSS - Mall Road Khairpur

1. Immediate Action Plan

The immediate action plan will focus on the following key areas for each school:

Structural Repairs and Stability:

- Address cracks, roof leaks, and other structural issues to ensure the safety of students and staff.
- Reinforce weak structures and repair damaged walls, floors, and ceilings.

Access to Basic Utilities:

- Provide electricity connections and install energy-efficient lighting systems.
- Ensure a clean and reliable water supply by installing water tanks and filtration systems.
- Construct gender-segregated toilets with proper sanitation facilities.

Provision of Essential Facilities:

- Replace old and broken furniture with new desks, chairs, and benches.
- Build playgrounds and recreational areas to promote physical activity and holistic development.
- Equip classrooms with modern teaching aids such as whiteboards, projectors, and computers.

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Security Measures:

- Install boundary walls and secure gates to ensure the safety of students and school property.
- Set up CCTV cameras and hire security personnel to monitor school premises.

Staffing and Capacity Building:

- Ensure the presence of adequate teaching and non-teaching staff.
- Provide training for teachers on modern teaching methodologies and classroom management.

2. Cost Estimation for Rehabilitation and Provision of Facilities

The table below provides a detailed breakdown of the rehabilitation and provision of facilities for each school in the core urban area of Khairpur city.

This table provides a clear and structured breakdown of the rehabilitation costs for each school, ensuring transparency and facilitating effective planning and implementation.

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Table 6-6, List of Schools for Rehabilitation – Khairpur

Sr. No.	Institute Name	Area (Ha)	Rehabilitation Required - Area wise or Job wise Cost (PKR) (In millions)						
			Street / Road / Parking	Utility Facilities			Play grounds	School Building/ Classrooms Repair/ Renovation	Security
				Electricity (Electricity + Fire Alarm + HVAC + Telephone + Public Address)	Water Supply	Sewerage			
1	GBELS - Azam Colony	0.92	20.30	573.26	27.89	18.59	5.57	774.67	46.48
2	GBELS - Govt. Elementary School attached GECE (M)	0.13	-	414.02	20.14	13.43	-	559.48	33.57
3	GBELS - Mill Colony	0.29	3.57	509.56	24.79	16.53	0.98	688.60	41.32
4	GBHS - Bhurgari Khairpur Mirs	0.53	6.04	987.28	48.03	32.02	1.66	1,334.16	80.05
5	GBPS - Shaman Ali Shaikh	0.07	-	222.93	10.85	7.23	-	301.26	18.08
6	GBPS - Luqman	0.11	0.55	286.63	13.94	9.30	0.15	387.34	23.24
7	GBPS - Staff Quarter	0.07	-	222.93	10.85	7.23	-	301.26	18.08
8	GBPS - Suming (Gari-Pull)	0.04	-	127.39	6.20	4.13	-	172.15	10.33
9	GBPS - Khairpur No.1	0.19	2.19	350.32	17.04	11.36	0.60	473.41	28.40
10	GBPS - Khairpur	0.06	-	191.09	9.30	6.20	-	258.22	15.49

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Sr. No.	Institute Name	Area (Ha)	Rehabilitation Required - Area wise or Job wise Cost (PKR) (In millions)						
			Street / Road / Parking	Utility Facilities			Play grounds	School Building/ Classrooms Repair/ Renovation	Security
				Electricity (Electricity + Fire Alarm + HVAC + Telephone + Public Address)	Water Supply	Sewerage			
	No.2								
11	GGPS - Jillani Mohalla	0.12	-	382.17	18.59	12.39	-	516.45	30.99
12	GGPS - Luqman (Hockey Ground)	0.13	-	414.02	20.14	13.43	-	559.48	33.57
13	GGPS - Saida Goth	0.06	-	191.09	9.30	6.20	-	258.22	15.49
14	GGLSS - Sultan Madaris	0.06	-	191.09	9.30	6.20	-	258.22	15.49
15	GBHS - GHS. Saint Theresas	1.23	18.66	1,751.62	85.21	56.81	5.12	2,367.05	142.02
16	GGHS - Luqman	0.22	-	700.65	34.09	22.72	-	946.82	56.81
17	GGHS - Nizamani	0.7	6.04	1,528.68	74.37	49.58	1.66	2,065.79	123.95
18	GGHSS - Mall Road Khairpur	0.68	6.04	1,464.99	71.27	47.51	1.66	1,979.71	118.78
Total		5.61	63.38	10,509.70	511.28	340.86	17.40	14,202.30	852.14
Total Cost (PKR)		**26,497.06**							

Source: *The Consultant Team*

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1. Implementing Authority

- District Education Works and Services Department, Government of Sindh
- Collaborating Partners: Local NGOs, community organizations, and private sector stakeholders.

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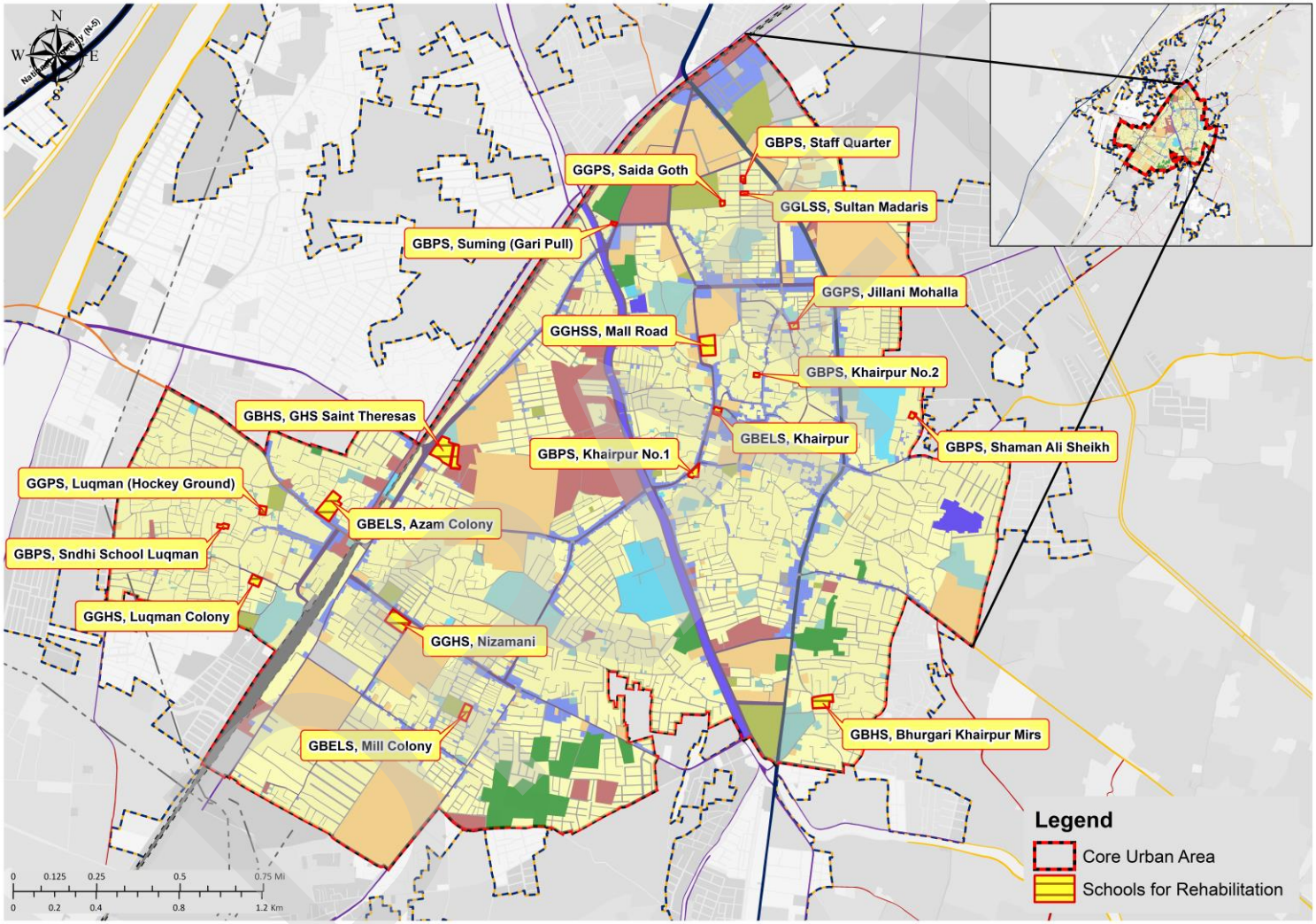


Figure 6-7, Education Institutes in Core Urban Area – Khairpur

***Source**: The Consultant Team*

6.3 Health

6.3.1 Existing Situation

A. District Level Healthcare Facilities

Rapid population expansion has created significant strain on healthcare services and infrastructure. The existing facilities in district Khairpur are inadequate and poorly distributed geographically. The prevalence of inadequate personal hygiene practices, inadequate community sanitation, contaminated and limited water resources, and ineffective waste disposal systems has resulted in elevated rates of illness and death.

A hierarchical structure for healthcare facilities exists nationwide, yet it lacks comprehensiveness, with rural regions largely dependent on urban centres for both general and specialized healthcare. Nonetheless, there is an urgent requirement to transition from this centralized model towards establishing localized healthcare facilities, particularly for general health services tailored to the needs of each area. The overall number of health facilities and number of medical and para medical staff present in Khairpur district are mentioned below.

Table 6-7, Number of Healthcare Facilities in Khairpur District

Healthcare Facilities	Medical Centres	Beds
Hospitals	21	
• District Head Quarter (DHQ)	1	-
• Taluka Head Quarter (THQ)	1	30
• Major/Other/Specialized Hospitals Secondary	19	-
Basic Health Units (BHUs)	**83**	**166**
Rural Health Centres (RHCs)	**11**	**106**
Dispensaries	**95**	**52**
• Government	52	0
• Semi Government	4	12
• Local Bodies	31	0
• Private	8	40
Tb Clinics	**11**	**0**
• Government	11	0
• Private	0	0
Mother and Child Health Centres (MCHC)	**5**	**10**
• Government	5	10
• Semi-Government	0	0

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Healthcare Facilities	Medical Centres	Beds
• Local Bodies	0	0
• Private	0	0
Maternity Homes (Government)	**4**	**NA**

Source: *Sindh District Profile, 2021*

The **Table** 6-8 shows total number of medical professionals and para-medical staff, encompasses doctors, specialists, surgeons, nurses, midwives, pharmacists, laboratory technicians, radiographers, and other allied healthcare professionals. It includes both government-employed and private practitioners operating in the district.

Table 6-8, Number of Medical and Para medical staff in Khairpur District

Staff	No.
Doctors/GMO	628
Dentists	11
Physician	2
Surgeons	3
Gynaecologist	6
Paediatricians	6
Nurses	69
Paramedical Staff	742

Source: *Sindh District Profile, 2021*

In Khairpur district, the population served by health facilities faces notable challenges in terms of patient-to-healthcare-provider ratios. With a staggering patient-per-bed ratio of 3,193 persons, healthcare infrastructure seems overburdened and potentially strained. This ratio suggests a significant scarcity of hospital beds relative to the population's healthcare needs, potentially leading to overcrowding and compromised quality of care as the World Health Organization (WHO) standards suggest a minimum of 3 beds per 1000 is required. Moreover, the patient-per-doctor ratio stands at 3,881, although WHO prescribes the ratio of 1:1000, that is, one doctor for a population of 1000 individuals. This indicates a substantial demand for medical attention compared to available physician resources. This imbalance could potentially lead to longer waiting times, reduced consultation durations, and compromised patient outcomes. Similarly, with a patient-per-nurse ratio of 36,275, there is a pronounced shortage of nursing staff to adequately address the healthcare needs of the community. This scarcity may result in diminished patient care quality, increased workload for nurses, and potential burnout.

The coronavirus disease 2019 (COVID-19) has received various distinct perspectives and responses at the local as well as global levels. **Table** 6-9 represents COVID 19 prevalence in Khairpur district with total cases, case fatality rate, and recovery rate.

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Table 6-9, COVID 19 Statistics in Khairpur District 2020

Total cases	Deaths	Prevalence%13	CFR%14	CRR%15
3027	23	0.1	0.8	99.2

Source: *Umar A., 2021*

B. City Level Healthcare Facilities

The overall condition of public health care in the city is also concerning, as indicated by data gathered from the Land use Survey 2023, as shown in **Table** 6-10. The rapid increase in population has significantly strained health services and facilities. The existing infrastructure is inadequate and poorly distributed spatially. Elevated morbidity and mortality rates are attributed to factors such as limited awareness of personal hygiene, inadequate community sanitation practices, impure and insufficient water supply, and deficient refuse disposal systems.

The public health care facilities in Khairpur city are overall satisfactory. However, the city lacks sufficient clinics and dispensaries despite the presence of District Head Quarter (DHQ) and Basic Health Unit (BHU). Additionally, few private practitioners offer health care services to the population.

Table 6-10, Number of Healthcare Facilities in Khairpur City

Healthcare Facilities	Count
District Headquarter Hospital (DHQ)	1
Basic Health Unit (BHU)	1
Hospitals	19
Clinics	25
Dispensaries	2

Source: *The Consultant Team*

Land use analysis reveals that healthcare facilities occupy only 13.3 sq.km. (0.53%), falling below the recommended planning standard of 2-3%. In addition to the limited land coverage, Khairpur city is experiencing a shortage of health facilities, highlighting crucial need for the development of healthcare facilities in the area.

According to the socio-economic survey 2023, there is a clear trend indicating that government healthcare services are more widely available compared to private services in Khairpur city. Approximately 55% of

[13] *the total number of individuals in a population who have a disease or health condition at a specific period of time, usually expressed as a percentage of the population.*
[14] *CFR is defined as the ratio between the total number of deaths due to pandemic COVID-19 and total infected individuals from pandemic COVID-19.*
[15] *CRR is the proportion of recovered or discharged individuals with a specified health condition compared to total infected cases.*

government facilities have regular availability of doctors, while only 2% of private healthcare services fall into the same category. Additionally, a significant portion of government services (13%) have partial availability of doctors within a hospital, in contrast to private services shown in the **Figure** 6-8.

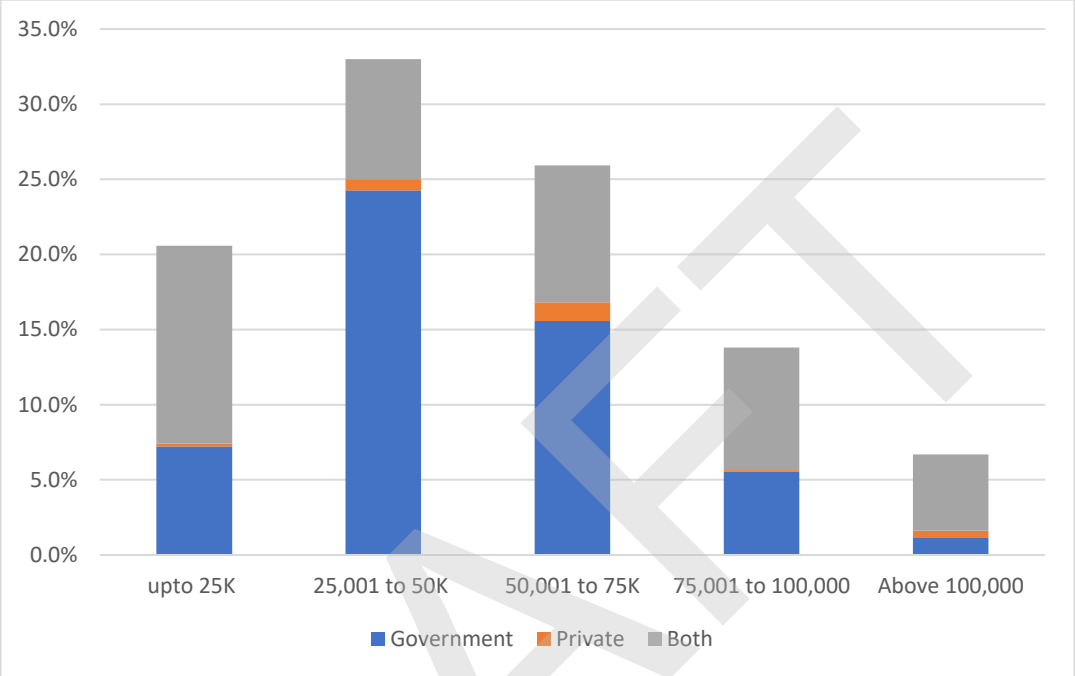


Figure 6-8, Correlation between Healthcare Facilities and Doctor Availability

Source: *The Consultant Team*

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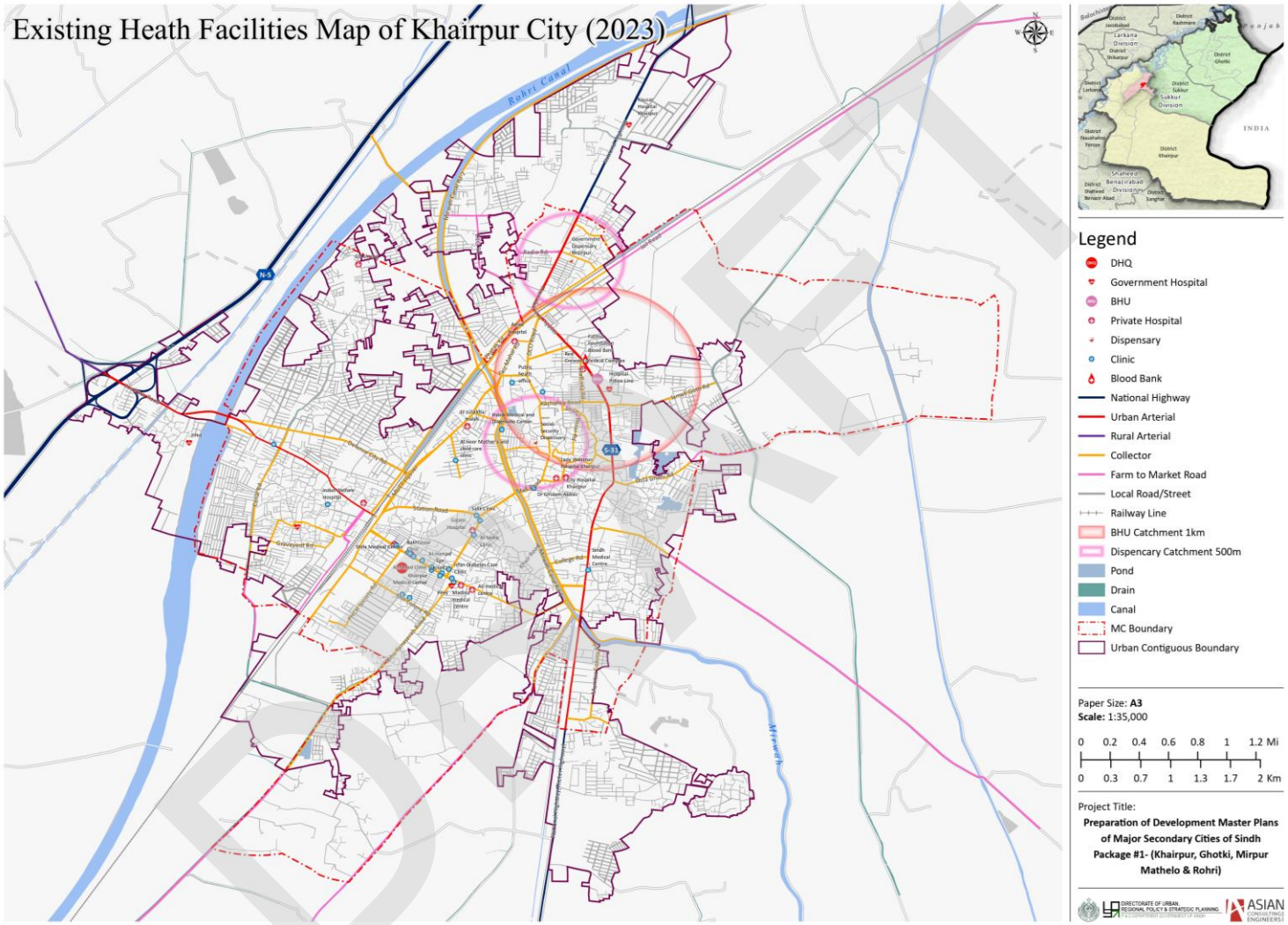


Figure 6-9, Existing Health Facilities Map of Khairpur City

Source: *The Consultant Team*

6.3.2 SWOT Analysis

Strengths	Weaknesses
• There is one specialized hospital in city. • The presence of DHQ (District Headquarters) hospital provides basic healthcare services to the population.	• The current number of beds and medical facilities does not meet the demand of the current population. • Existing healthcare facilities are often inadequate and lack essential medical equipment and resources necessary for effective treatment.
Opportunities	**Threats**
• Potential to attract investment in specialized healthcare facilities due to increasing demand. • Investments can be made through public-private partnerships to enhance service delivery	• Population growth in Khairpur may exacerbate existing healthcare challenges, if infrastructure does not keep pace with demand.

6.3.3 Need Assessment

To bridge the existing gaps and improve healthcare outcomes for the population, there is a need to increase human resources by recruiting more doctors, nurses, midwives, and paramedical staff is crucial to meet recommended patient-to-provider ratios. Elevating the level of medical service delivery by investing in training initiatives for healthcare staff and establishing oversight mechanisms for accountability remains indispensable. Furthermore, strengthening public health measures by implementing community-based programs focusing on hygiene education, clean water supply projects, and waste management systems will help address preventable diseases. Leveraging technology by introducing telemedicine services and electronic medical records systems can also improve healthcare delivery. Lastly, increasing land allocation for healthcare facilities in Khairpur city to meet the recommended standard of 2-3% is vital for accommodating future healthcare needs.

A. Land Suitability Analysis of Health

Land suitability analysis (LSA) for healthcare facilities in Khairpur city (**Figure** 6-10) is crucial in identifying optimal locations that enhance accessibility and meet community health needs. Key considerations include proximity to major roads such as National Highway, Jail Road, Mirwah Canal Road and Shadi Shaheed Road, as these roads facilitates easy access to patients and emergency services. Ideally, sites within 500 meters are considered highly suitable to ensure rapid response times, while those beyond 2,000 meters are

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deemed unsuitable. Sites should also be located near residential areas to ensure that communities can conveniently reach healthcare services, with a recommended distance of no more than 500 meters.

Additionally, the analysis must take into account environmental factors, avoiding locations near hazardous sites such as industrial areas or flood-prone zones to ensure patient safety. Sites should instead be close to parks and open spaces, which enhance the environment for healthcare services. Accessibility to essential services, such as pharmacies and laboratories, is also important as it enhances the overall healthcare experience. By focusing on these criteria, land suitability analysis helps ensure that healthcare facilities are strategically placed to serve the population effectively and equitably.

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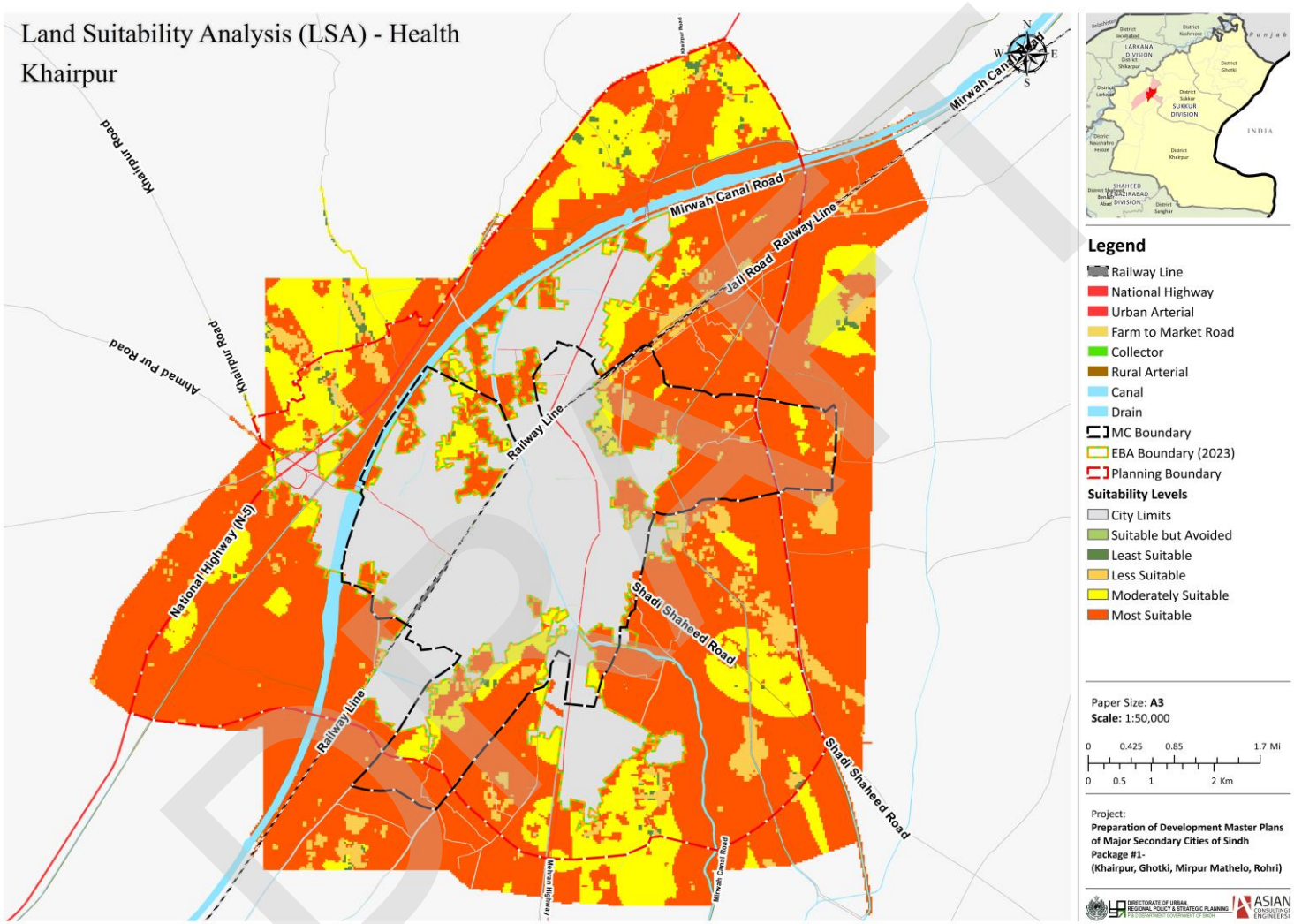


Figure 6-10, Land Suitability Analysis – Health

Source: *The Consultant Team*

6.3.4 Policy Guidelines

The health sector in Khairpur city must be developed in alignment with existing laws, policies, rules, and regulations at the federal, provincial, and local levels. The following policy guidelines are framed with respect to the available legal framework to ensure effective implementation and compliance.

A. Policy Measures for Healthcare Infrastructure

Construction and Upgradation of Healthcare Facilities

Under the Sindh Local Government Act (2013), the provincial and local authorities shall prioritize the construction and upgradation of healthcare facilities, including hospitals, clinics, and basic health units (BHUs), in Khairpur District. These facilities shall be equipped with essential medical equipment, medicines, and trained staff.

Disaster-Resilient Healthcare Facilities

In compliance with the Sindh Building Control Ordinance (1979) and National Disaster Management Authority (NDMA) Guidelines, all new healthcare facilities shall be constructed using disaster-resilient designs, especially in flood-prone areas. Existing facilities in hazardous zones shall be retrofitted to withstand natural disasters.

B. Policy Measures for Access to Healthcare

Mobile Health Units

Under the Sindh Local Government Act (2013), mobile health units shall be deployed to provide healthcare services in remote and underserved areas of Khairpur District. These units shall offer basic medical care, vaccinations, and maternal and child health services.

Ambulance Services

To improve access to emergency healthcare, the Sindh Local Government Act (2013) shall be utilized to establish a network of ambulance services. These services shall be equipped with basic life support systems and staffed by trained paramedics.

C. Policy Measures for Quality Healthcare

Training and Recruitment of Healthcare Professionals

Under the Pakistan Medical and Dental Council Act (2022), a comprehensive training program shall be implemented to improve the skills of healthcare professionals. Vacant positions in healthcare facilities shall be filled through transparent recruitment processes, ensuring that only qualified and trained professionals are hired.

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Standard Treatment Protocols

The Sindh Healthcare Commission Act (2013) shall be enforced to ensure that all healthcare facilities follow standard treatment protocols. Regular audits shall be conducted to monitor compliance and improve the quality of care.

D. Policy Measures for Maternal and Child Health

Maternal and Child Health Clinics

Under the Sindh Local Government Act (2013), maternal and child health clinics shall be established in all healthcare facilities. These clinics shall provide antenatal and postnatal care, immunizations, and nutritional support to mothers and children.

Awareness Campaigns

Awareness campaigns shall be conducted under the Sindh Transparency and Right to Information Act (2016) to educate communities about the importance of maternal and child health. These campaigns shall focus on promoting safe childbirth practices, breastfeeding, and immunization.

E. Policy Measures for Disease Prevention and Control

Vaccination Programs

Under the Sindh Immunization and Epidemics Control Act (2023), vaccination programs shall be implemented to prevent the spread of infectious diseases. Special attention shall be given to polio, measles, and hepatitis vaccination campaigns.

Vector Control Programs

To combat vector-borne diseases such as malaria and dengue, the Sindh Local Government Act (2013) shall be utilized to implement vector control programs. These programs shall include community education, insecticide spraying, and environmental management.

F. Policy Measures for Mental Health

Mental Health Services

Under the Sindh Mental Health Act (2013), mental health services shall be integrated into primary healthcare facilities. Trained mental health professionals shall be deployed to provide counselling and treatment for mental health conditions.

Awareness and Stigma Reduction

Awareness campaigns shall be conducted to reduce the stigma associated with mental health issues. These campaigns shall be supported by the Sindh Transparency and Right to Information Act (2016) to ensure widespread dissemination of information.

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G. Policy Measures for Monitoring and Evaluation

Regular Inspections

Under the Sindh Health Care Commission Act (2013), regular inspections shall be conducted to monitor the performance of healthcare facilities. Inspection reports shall be made publicly available to ensure transparency.

Performance Metrics

Performance metrics shall be developed to evaluate the effectiveness of healthcare policies and programs. Data-driven improvements shall be made to address gaps and ensure continuous progress.

Feedback Mechanisms

Feedback mechanisms shall be established to gather input from patients, healthcare providers, and community members. This feedback shall be used to make necessary adjustments to healthcare policies and practices.

6.3.5 Strategic Development Plan

Khairpur city faces substantial healthcare challenges, including inadequate infrastructure, a lack of tertiary care facilities, poorly equipped hospitals, and insufficient access to quality healthcare services. Strengthening the healthcare system through infrastructure development, improved service delivery, and capacity-building is essential. Key improvements include enhancing healthcare facilities, ensuring the availability of modern equipment, and promoting accountability in health departments. Governance can be improved through public-private partnerships, IT-based monitoring systems, and equitable resource allocation. A focus on preventive care, awareness campaigns, and skilled workforce development will ensure long-term progress in public health.

A. Long-Term Plan

- Construct a 200-bed specialized hospital near Mehran University (MUET) with:
  - Trauma center (linked to National Highway accidents).
  - Cardiology and oncology units (reducing referrals to Sukkur and Hyderabad).
  - Paediatric and maternity wards (addressing high maternal mortality).
- Establish new BHUs in underserved areas (Burghari, Faizabad Colony, Phatak Road).
- Partner with SALU and MUET for medical training programs.
- Collaborate with Aga Khan Health Services for specialist OPDs at DHQ Hospital.
- Incentivize private clinics in commercial zones (Mall Road, Jail Road) via tax breaks.

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B. Short-Term Plan

- Deploy more ambulances (linked to 1122 emergency service) with GPS tracking.
- Train community health workers for first-aid and disease surveillance.
- Upgrade DHQ hospital equipment and ensure the consistent availability of quality medicines.
- Provide additional facilities such as furnished accommodation, discounted utility bills, and transportation allowances to attract healthcare professionals to work in rural areas.
- Equip all BHUs with:
  - Solar-powered refrigerators (vaccine storage).
  - Telemedicine kits (for remote consultations).
- Monthly hygiene camps in slums (Jinnah Colony, Banarsi Colony).
- Dengue/larvicidal spraying in waterlogged areas (near Rohri Canal).
- Introduce IT-based monitoring systems to improve accountability and efficiency in healthcare delivery.

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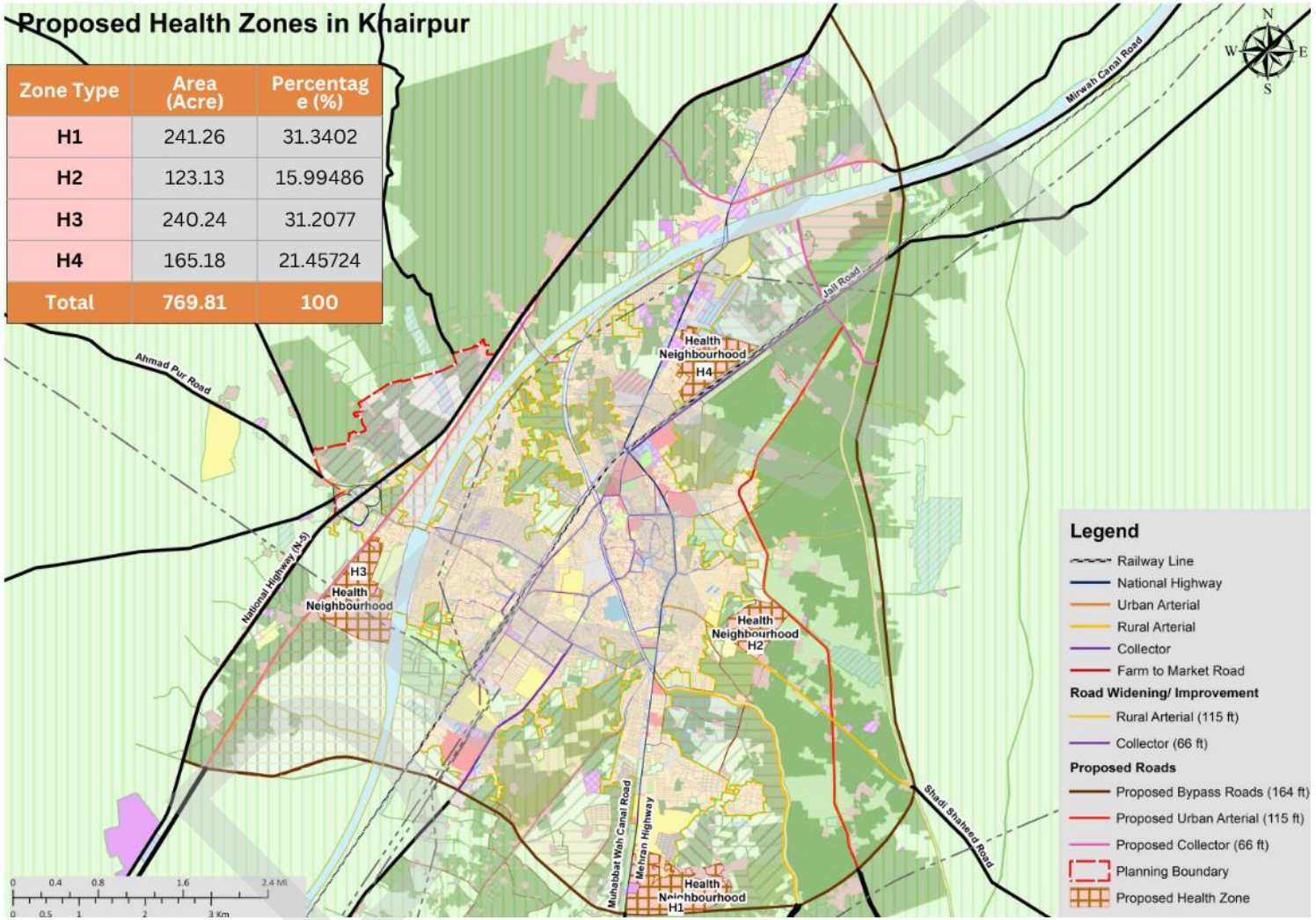


Figure 6-11, Proposed Health Zones in Khairpur

Source: *The Consultant Team*

6.3.6 Priority Projects

Healthcare is a cornerstone of urban development and a fundamental right of every citizen. In Khairpur city, the current state of public healthcare is alarming, with inadequate infrastructure, insufficient facilities, and a severe shortage of medical professionals. The rapid population growth has further strained the already overburdened healthcare system, leading to elevated morbidity and mortality rates. To address these challenges, priority projects will focus on expanding healthcare infrastructure, improving service delivery, and ensuring equitable access to quality healthcare for all residents.

A. Repair, Rehabilitation and Upgradation of Medical Facilities in District Headquarter (DHQ) Hospital, Khairpur

1. Project Justification

The healthcare system in Khairpur city is critically underdeveloped, with only 1 District Headquarter (DHQ) Hospital, 1 Basic Health Unit (BHU), 19 hospitals, and 25 clinics serving a population of 286,757. Healthcare facilities occupy a mere 13.25 hectares (0.53%) of land, significantly below the recommended planning standard of 2-3%. The lack of specialized facilities, such as trauma centres, maternity homes, and paediatric care units, has further exacerbated the challenges. Additionally, the uneven spatial distribution of healthcare facilities leaves many areas underserved, particularly in rural and peri-urban areas.

This project is essential to transform the DHQ Hospital into a robust, well-equipped medical hub that provides equitable, accessible, and quality healthcare to reduce patient burden and improve community health outcomes.

2. Project Scope

This project will comprehensively rehabilitate, upgrade, and expand the DHQ Hospital to meet provincial standards for a District Headquarter facility. The scope of work is detailed below:

- Execute structural repairs to the main building, including concrete crack injection and complete weatherproof re-roofing. Fully refurbish interiors with repainting, replacement of all doors and windows, and upgrading patient toilets with modern, accessible sanitary ware.
- Equip the hospital with essential diagnostic and treatment technology, including a Digital X-Ray machine, an Ultrasound system, and modern laboratory analysers for haematology and biochemistry to enable accurate and timely diagnosis.
- Provision of modern medical equipment for diagnostics, monitoring, and treatment across key departments. Upgrades to essential systems like reliable power backup (generators/UPS), oxygen supply, and water sanitation.

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- Improve the hospital's functionality and patient experience by rehabilitating internal roads and parking, creating a covered waiting area, and upgrading the waste management system with color-coded bins and a sharps disposal unit for safety and hygiene.
- Lay the foundation for digital healthcare management by implementing structured LAN cabling and providing computers with software for a Hospital Management Information System (HMIS) to streamline patient records and hospital administration.

3. Project Benefits

- **Improved Healthcare Delivery:** The rehabilitation and upgradation of medical facilities will enable the DHQ Hospital to deliver quality healthcare services, reducing the burden on other facilities.
- **Enhanced Patient Care:** Specialized units and modern equipment will ensure comprehensive care for trauma, maternal health, paediatrics, and emergencies.
- **Increased Capacity:** Expanded bed capacity and improved infrastructure will allow the hospital to serve more patients effectively.
- **Better Public Health Outcomes:** Access to quality healthcare will reduce morbidity and mortality rates, improving overall public health in the district.
- **Strengthened Healthcare System:** The project will contribute to a more resilient and efficient healthcare system in Khairpur city.

4. Implementation Strategy

Phase 1: Assessment and Detailed

- Conduct a comprehensive structural and engineering assessment of the DHQ Hospital to finalize technical specifications.
- Complete detailed architectural and engineering designs for the new annex and upgraded facilities.
- Finalize tender documents and initiate a transparent procurement process for contractors and equipment.

Phase 2: Infrastructure and Civil Works

- Execute structural repairs, including crack injection, re-roofing, and interior refurbishment.
- Carry out upgrades to critical utility systems, including electrical, water, and sanitation infrastructure.

Phase 3: Equipment Installation and System Integration

- Procure, deliver, and install all medical and non-medical equipment (e.g., X-ray, ultrasound, laboratory analysers, HMIS).

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- Install and commission the power backup generators, central oxygen system, and water filtration plant.
- Conduct rigorous testing and calibration of all new systems and equipment.

Phase 4: Staff Training and Operationalization

- Conduct specialized training programs for medical, nursing, and technical staff on the use of new equipment and protocols.
- Develop and implement new operational and maintenance procedures for the upgraded facilities.

Phase 5: Monitoring and Evaluation

- Establish a monitoring mechanism to track hospital performance indicators (e.g., patient load, service delivery).
- Conduct a post-project evaluation to assess impact on patient outcomes, staff efficiency, and community satisfaction.
- Ensure the implementing authority has a long-term maintenance plan in place.

5. Implementing Authority

- District Health Department, Government of Sindh
- Public Health Engineering Department
- Local Government and Rural Development Department

6. Estimated Cost

Total Estimated Cost: Rs. 3,663.09 million (approx.)

6.3.7 Immediate Action Plan for Core Urban Area

A. Provision of Missing Facilities to District Headquarter (DHQ) Hospital, Khairpur

The DHQ Hospital in Khairpur city is a critical healthcare facility serving a population of 286,757, yet it lacks essential facilities, severely impacting its ability to deliver quality healthcare services. This immediate action plan focuses on addressing these critical gaps by repairing and rehabilitating the hospital infrastructure, providing missing facilities, and ensuring a safe and functional healthcare environment for patients and staff.

The following key areas of the DHQ Hospital have been prioritized for immediate intervention:

- Emergency and Trauma Care Unit
- Maternity Ward
- Paediatric Care Unit
- Diagnostic Laboratory
- Pharmacy
- Staff Accommodation

1. Immediate Action Plan

The immediate action plan will focus on the following key areas for the DHQ Hospital:

Structural Repairs and Stability

- Address structural issues such as cracks, roof leaks, and damaged walls to ensure the safety of patients and staff.
- Reinforce weak structures and repair damaged floors, ceilings, and operational areas.

Access to Basic Utilities

- Provide a reliable water supply by installing water storage tanks and filtration systems.
- Ensure uninterrupted electricity by setting up generators or solar power systems.
- Construct proper sanitation facilities and establish a waste disposal system.

Provision of Essential Facilities

- Procure and install essential medical equipment, including ventilators, ECG machines, ultrasound devices, and laboratory tools.
- Establish a fully equipped diagnostic laboratory for basic and advanced diagnostic tests.
- Set up a dedicated emergency and trauma care unit with modern equipment and trained staff.
- Create a fully functional maternity ward for safe deliveries and postnatal care.
- Develop a paediatric care unit with child-friendly facilities and specialized equipment.
- Ensure a fully stocked pharmacy with essential medicines and supplies.

Security Measures

- Reconstruct and rehabilitation of boundary walls and secure gates to ensure the safety of patients, staff, and hospital property.
- Set up CCTV cameras and hire security personnel to monitor hospital premises.

Staff Accommodation and Capacity Building

- Provide temporary accommodation for doctors and paramedics to attract and retain skilled healthcare professionals.
- Organize training sessions for hospital staff on the use of new equipment and emergency care protocols.

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2. Cost Estimation

Sr. No.	Department/ Facility	Components	Estimated Cost* (In millions)
1	Diagnostic Wing	CT, MRI, X-ray, Ultrasound	7.215
2	Specialist Equipment	Cardiology, Neurology, etc. equipment	199.6
3	Training and Housing	Staff development and accommodations	0.8
Total			**207.6**

Source: *The Consultant Team*

**It does not include equipment cost.*

3. Implementing Authority

- District Health Department, Government of Sindh
- Public Health Engineering Department
- Local Government and Rural Development Department
- Collaborating Partners: Local NGOs, private sector stakeholders, and community organizations.

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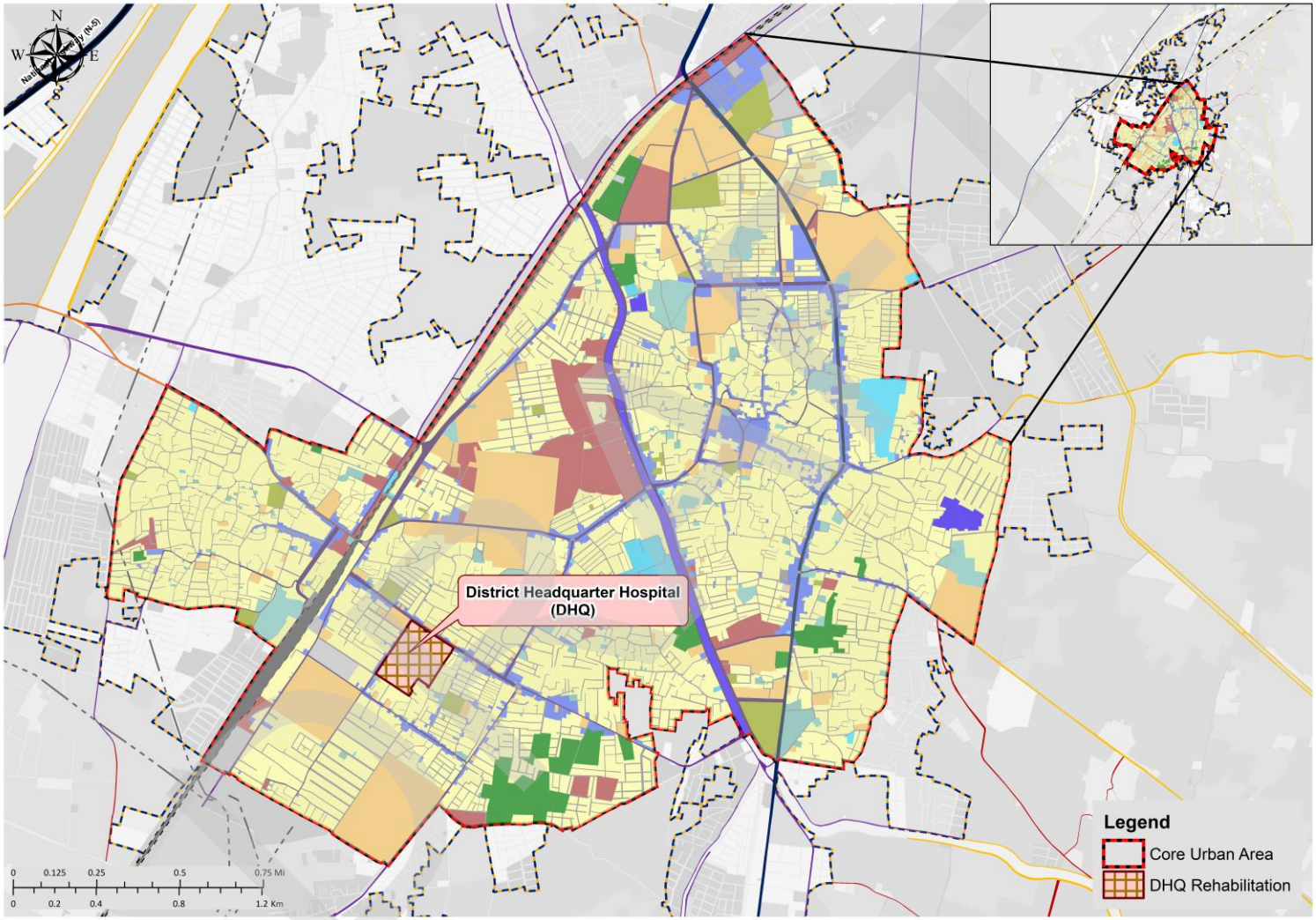


Figure 6-12, Healthcare Facility in Core Urban Area – Khairpur

***Source**: The Consultant Team*

6.4 Recreation

6.4.1 Existing Situation

Khairpur city currently faces significant deficiencies in its parks and recreational infrastructure, which negatively impact residents' quality of life. The city has only a handful of public parks, including Bilawal Bhutto Park, Sardar Shadeen Family Park, Ladies Park, along with a few neighbourhoods open spaces. The distribution of recreational spaces (as shown in **Figure** 6-13) across Khairpur is highly uneven, creating accessibility challenges for many residents. While some central areas have park facilities, the northwestern sectors of the city are particularly underserved, with no proper recreational spaces available. This inequitable distribution forces residents in these areas to either travel long distances to access parks or go without such facilities entirely. The number of available open spaces is mentioned in the **Table** 6-11.

Table 6-11, Number of Open Space Facilities in Khairpur City

Recreation Facilities	Count
Playground	3
Neighbourhood Park	3
Community Level Park	8
Stadium	1

Source: *The Consultant Team*

The parks and open space access metrics will consider two key data points to determine the gaps in the existing facilities which includes:

- How many hectares of park space, per 1,000 residents, are within a 500m walk distance on average; and
- Given the projected population of the city, how many total hectares of park space will be needed in future.

There are certain standards for open spaces set by World Health Organization (WHO) that is 9 km^2 per person within 15-minute walking distance and according to UN-Habitat open spaces should be accessible within 800 meters[16]. According to National Reference Manual there is a need of 1-7% of open space/recreational areas these standards can be utilized for the provision of adequate open spaces in the future. According to the standards discussed there is lack of appropriate open spaces in the city.

[16] https://www.bip.org.bd/admin/uploads/bip-publication/publication-24/paper/20201002102922.pdf

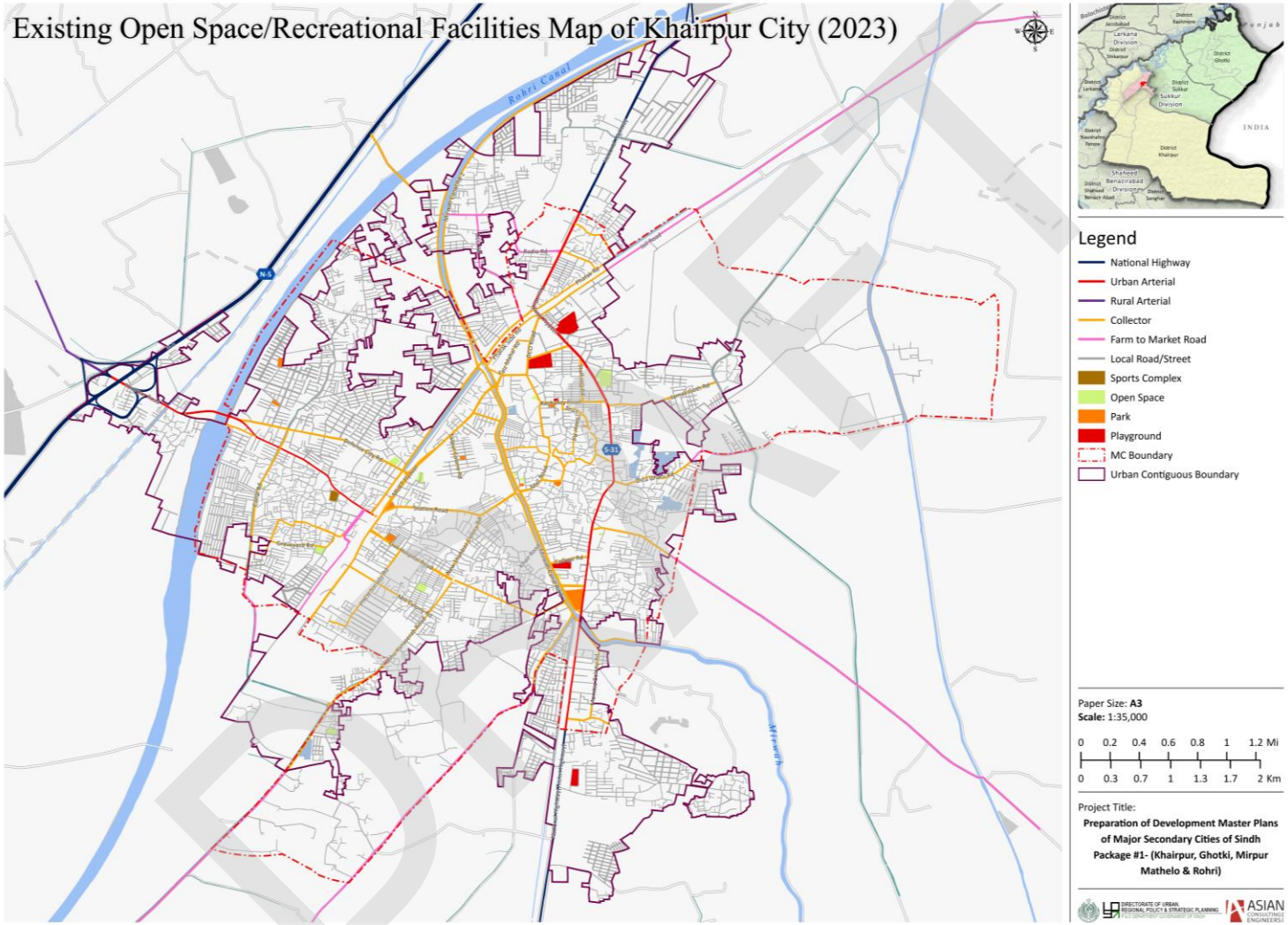


Figure 6-13, Existing Open Space/ Recreational Facilities Map of Khairpur City

Source: *The Consultant Team*

6.4.2 SWOT Analysis

Strengths	Weaknesses
• The city features various recreational facilities, including the Rahmowali park and a sports complex, catering to different community needs for leisure and physical activities.	• There is an uneven distribution of parks, particularly a lack of adequate recreational spaces limiting access for residents in those areas. • Existing parks may suffer from deferred maintenance or inadequate resources, impacting their usability and attractiveness.
Opportunities	**Threats**
• Vacant spaces can be transformed into parks or green spaces, providing residents with accessible recreational areas.	• Rapid urbanization may threaten existing recreational spaces if not properly managed, leading to potential loss of open areas.

6.4.3 Need Assessment

Currently, the city has a mix of recreational spaces, including Mohalla parks, neighbourhood parks, community-level parks, open spaces, playgrounds, and sports complexes. However, there is a notable disparity in the distribution of these spaces, particularly on the southern and northern side of city. This disparity needs to be addressed to enhance the quality of life for residents and contribute to the city's vision of fostering a healthy and active community. According to international standards, such as those set by the World Health Organization (WHO) and UN-Habitat, cities should aim to provide accessible open spaces within walking distances. The WHO recommends at least 9 square meters of open space per person, while UN-Habitat suggests that open spaces should be accessible within 800 meters.

To address the current shortcomings and meet future demands, there is need to focus on increasing its open space area by developing new parks and open spaces, particularly on the southern and northern side of city. Improving accessibility is also crucial, ensuring that open spaces are within 800 meters for most residents. Diversifying open space types to include both active and passive spaces will cater to different recreational needs. Enhancing existing parks and playgrounds to improve their quality and functionality is also essential. Lastly, involving local communities in planning and maintaining open spaces will ensure they meet residents' needs and preferences.

A. Land Suitability Analysis of Recreational Areas

Land suitability analysis (LSA) for recreational areas of Khairpur city (**Figure** 6-14) is essential for effective urban planning, focusing on identifying optimal locations that enhance community well-being and environmental quality.

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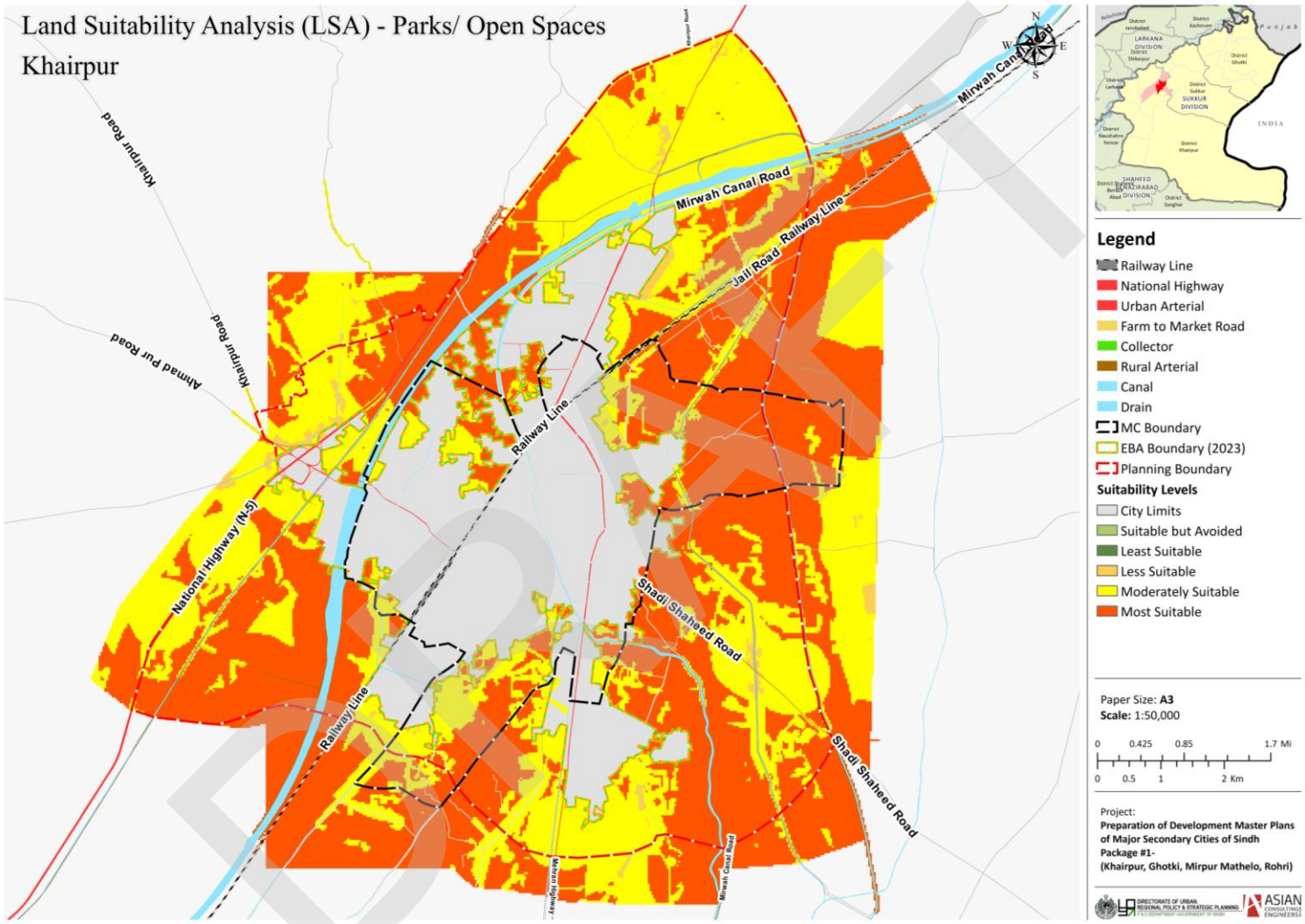


Figure 6-14, Land Suitability Analysis - Parks/ Open Spaces

Source: *The Consultant Team*

Key factors influencing suitability include proximity to residential areas, accessibility via major roads (within 500 meters), and the presence of existing green spaces. Ideal sites are typically located in flat areas, away from industrial zones and flood-prone regions, ensuring safety and accessibility for the public. Additionally, proximity to water access, particularly within 100 meters, are deemed most suitable for parks. This analysis aims to provide communities with accessible green spaces that promote physical activity, social interaction, and ecological benefits, ultimately contributing to a healthier urban environment.

6.4.4 Policy Guidelines

The development of parks, recreation, and sports facilities in Khairpur city must align with the broader goals of urban planning, community well-being, and sustainable development. These policy guidelines are framed within the context of the Sindh Local Government Act (2013) Sindh Environmental Protection Act (2014) and other relevant laws and regulations to ensure effective implementation and compliance.

A. Policy Measures for Parks and Green Spaces

Development of Public Parks

Under the Sindh Local Government Act (2013), the local government shall allocate land for the development of public parks in Khairpur city. These parks shall be designed to provide recreational spaces for all age groups, with features such as walking paths, playgrounds, and seating areas.

Green Spaces and Urban Forestry

In compliance with the Sindh Environmental Protection Act (2014), green spaces shall be integrated to improve air quality and provide environmental benefits. Urban forestry initiatives shall be promoted to increase tree cover and create shaded areas in parks and public spaces.

Maintenance and Upkeep

A dedicated budget shall be allocated under the Sindh Local Government Act (2013) for the maintenance and upkeep of parks and green spaces. Regular cleaning, landscaping, and repair of facilities shall be ensured to keep these areas safe and attractive for public use.

B. Policy Measures for Recreational Facilities

Community Centres

Under the Sindh Local Government Act (2013), community centres shall be established in Khairpur city to provide spaces for recreational activities, cultural events, and social gatherings. These centres shall be equipped with facilities such as libraries, auditoriums, and multipurpose halls.

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Children's Play Areas

Play areas for children shall be developed in residential neighbourhoods and public parks. These areas shall include safe and age-appropriate play equipment, ensuring accessibility for children with disabilities.

Walking and Cycling Tracks

Walking and cycling tracks shall be developed in parks to promote healthy lifestyles. These tracks shall be designed to ensure safety and connectivity within recreational facilities.

C. Policy Measures for Sports Facilities

Development of Sports Complexes

Under the Sindh Sports Board Ordinance of (1980), sports complexes shall be developed in Khairpur city to provide facilities for various sports, including cricket, football, basketball, and athletics. These complexes shall include playing fields, gymnasiums, and seating for spectators.

Community Sports Facilities

Smaller sports facilities, such as community gyms and multipurpose courts, shall be established in residential areas to encourage local participation in sports and physical activities.

Promotion of Traditional Sports

Traditional sports and games, such as cricket, futsal, volleyball, hockey, and throwball, as well as kodiko, shall be promoted to preserve cultural heritage and encourage community participation. Local tournaments and events shall be organized to foster a sense of community and healthy competition.

D. Policy Measures for Accessibility and Inclusivity

Universal Design Principles

All parks, recreational facilities, and sports complexes shall be designed in accordance with universal design principles to ensure accessibility for persons with disabilities, the elderly, and children. Ramps, accessible pathways, and inclusive play equipment shall be incorporated.

Gender-Sensitive Facilities

Separate spaces and facilities for women and girls shall be provided in parks and sports complexes to encourage their participation in recreational and sports activities. These spaces shall ensure privacy and safety.

E. Policy Measures for Monitoring and Evaluation

Regular Inspections

Under the Sindh Local Government Act (2013), regular inspections shall be conducted to monitor the condition and usage of parks, recreational facilities, and sports complexes. Inspection reports shall be made publicly available to ensure transparency.

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Performance Metrics

Performance metrics shall be developed to evaluate the effectiveness of policies and programs related to parks, recreation, and sports. Data-driven improvements shall be made to address gaps and ensure continuous progress.

Feedback Mechanisms

Feedback mechanisms shall be established to gather input from users and community members. This feedback shall be used to make necessary adjustments to policies and practices.

6.4.5 Strategic Development Plan

Khairpur city faces considerable challenges in providing adequate recreational spaces, including a lack of parks, poorly maintained facilities, and disparities in park distribution. Strengthening the city's recreational infrastructure through the development of new parks, rehabilitation of existing facilities, and equitable resource allocation is essential. Key improvements include enhancing the quality and accessibility of parks, ensuring the availability of modern recreational amenities, and promoting community engagement. Governance can be improved through public-private partnerships, and community involvement. A focus on environmental sustainability, cultural preservation, and youth development will ensure long-term progress in creating a healthy and vibrant urban environment.

A. Long-Term Plan

- Develop city level parks with advanced amenities such as sports complexes, jogging tracks, and cultural hubs to reduce the need for residents to travel to other cities for recreational activities.
- Create urban forests, green belts, and buffer zones along Mirwah canal and railway line to enhance the city's green cover and environmental sustainability.
- Ensure equitable access to parks by establishing new recreational spaces in underserved areas, particularly in the north-western part of the city.
- Establish multi-purpose community centres with indoor sports facilities, community centres, and cultural spaces to promote social interaction and youth development.
- Develop scenic spots along canals and historical sites to attract tourists and boost the loc al economy.
- Organize workshops, seminars, and community meetings to raise awareness about the importance of parks, environmental conservation, and healthy lifestyles.
- Collaborate with government departments and NGOs to ensure the ensure the maintenance and sustainability of recreational facilities.
- Use technology to monitor park usage, maintenance, and resource allocation for improved governance and accountability.

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B. Short-Term Plan

- Repair and upgrade existing parks such as Sadar Din Shah Family Park, Talpur Colony Park, etc., by improving infrastructure, adding amenities, and enhancing landscaping.
- Develop Mohallah parks in residential areas by converting unused or dilapidated spaces, ensuring accessibility within 800 meters as per UN-Habitat standards.
- Transform canals into recreational spots by constructing footpaths, walkways, and green belts, and installing benches and lighting.
- Develop synthetic playing turfs for football, hockey, and cricket to encourage sports participation among youth.
- Ensure the availability of clean drinking water, public toilets, and shaded seating areas in all parks.
- Involve local communities in the planning, development, and maintenance of parks to foster a sense of ownership and responsibility.
- Install modern recreational equipment such as fitness zones, children's play areas, and outdoor gyms to enhance usability.
- Lobby for increased funding for the development and maintenance of recreational facilities to support infrastructure improvements.

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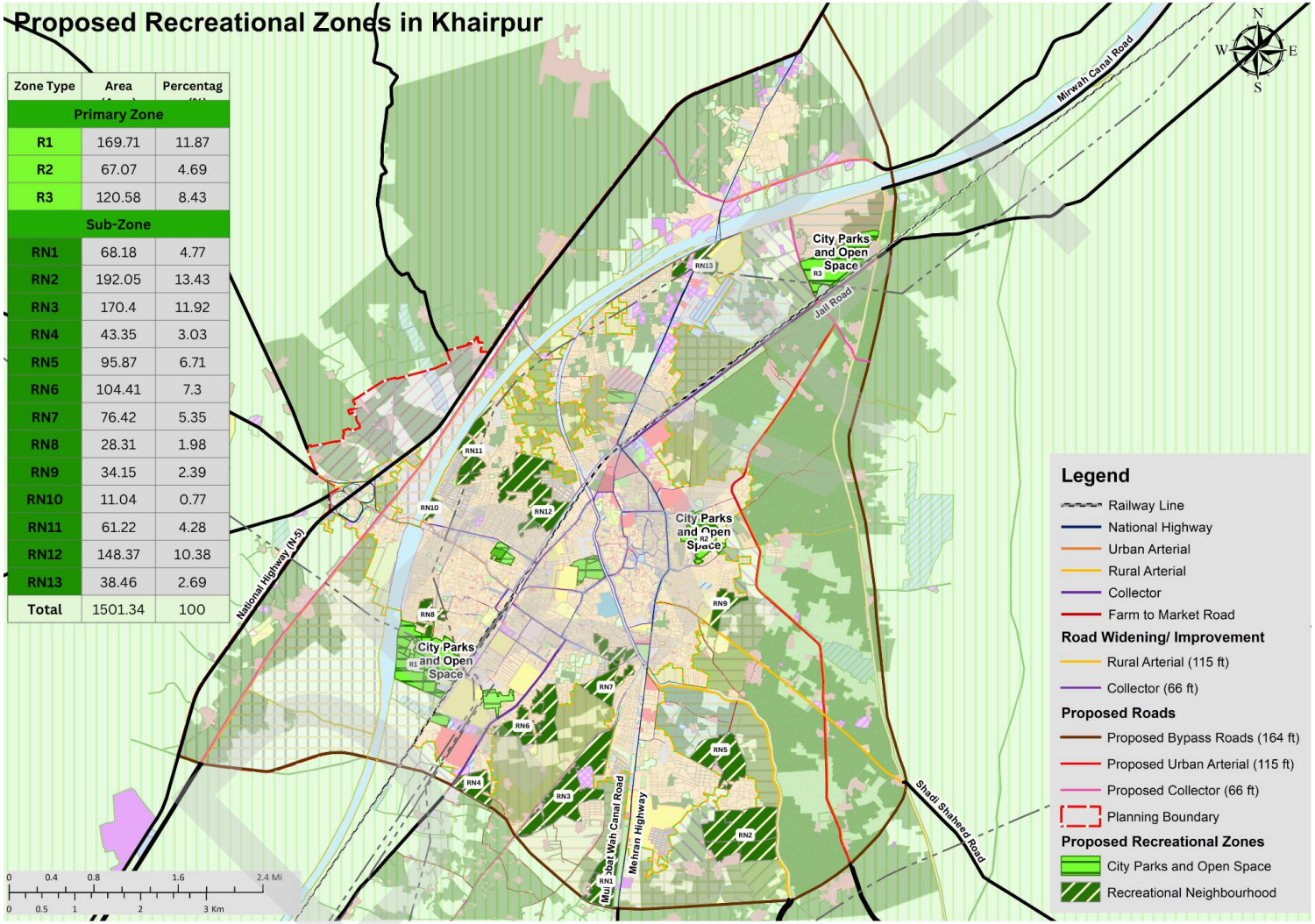


Figure 6-15, Proposed Recreational Zones in Khairpur

Source: *The Consultant Team*

6.4.6 Priority Projects

The development and rehabilitation of parks in Khairpur city are essential to addressing the growing need for accessible, safe, and well-maintained recreational spaces. The following priority projects aim to enhance the quality of life for residents by providing inclusive environments for physical activity, social interaction, and relaxation. By repairing and upgrading existing parks like Rahmowali Park, Railway Park, and Mumtaz Ground, the city will restore their functionality and appeal, ensuring they meet the needs of all age groups.

A. Enhancement of Recreational Facilities in Khairpur City

1. Project Justification

The availability of parks and recreational facilities in Khairpur city is essential for fostering a safe, healthy, and socially vibrant environment. While the city has made strides in developing recreational spaces such as Lala Mohkum Lashari Playground, Local or Neighbourhood Parks, or etc., there is a need to address the disparities in park distribution, particularly in the south-western part of the city. Additionally, existing parks require repair, rehabilitation, and provision of missing facilities to meet international standards and cater to the growing needs of the population.

This project is essential to rectify spatial inequities and transform dilapidated parks into safe, inclusive, and vibrant community hubs that promote public health and elevate the city's quality of life.

2. Project Scope

This project will address the recreational deficit through targeted rehabilitation of existing facilities. The scope of work is detailed below:

- Repair and upgrade of selected parks, including landscaping, pathway repairs, and installation of modern, safe play equipment.
- Installation of essential facilities across all project sites, including functional water fountains, gender-segregated public toilets, shaded seating areas, and adequate lighting for evening safety.
- Construction of walking/jogging tracks and the incorporation of universal access features like ramps to ensure the facilities are inclusive for children, the elderly, and persons with disabilities.

The following recreational facilities have been identified as priority projects:

Sr. No.	Name	Area (Ha)
1	Lala Mohkum Lashari Playground	1.28
2	Neighbourhood Park	0.60
3	Local Playground Area	0.51
Total		**2.40**

3. Project Benefits

- **Social Benefits:** Improved recreational spaces will promote positive social change, particularly for youth, by providing safe spaces for leisure and physical activities.
- **Health Benefits:** Enhanced parks will encourage a healthy and active lifestyle, reducing the prevalence of lifestyle-related diseases.
- **Economic Benefits:** The project will boost local economic potential, create employment opportunities, and enhance the city's landscape, making it more attractive for tourism and investment.
- **Environmental Benefits:** Properly managed parks and open spaces will improve drainage, preserve natural areas, and mitigate the impact of floods.

4. Implementation Strategy

Phase 1: Site-Specific Assessment and Community Consultation

- Conduct detailed topographical and condition surveys of selected parks.
- Hold community consultation workshops to gather input on desired facilities and design preferences.
- Finalize master plans and designs for each park, incorporating universal accessibility features.

Phase 2: Procurement and Site Preparation

- Finalize tender documents and award contracts for civil works and equipment supply.
- Clear sites, secure perimeters, and begin earthworks and grading.

Phase 3: Core Infrastructure Development

- Construct walking/jogging tracks, install underground utilities (water, electricity, drainage).
- Build and repair structural amenities such as public toilet blocks, shaded seating areas, and boundary walls.
- Install the foundational infrastructure for lighting and irrigation systems.

Phase 4: Installation of Amenities and Landscaping

- Install playground equipment, outdoor fitness stations, water fountains, and benches.
- Execute landscaping, including turfing, planting of trees and shrubs, and creation of green zones.
- Complete the installation of solar-powered LED lighting and security features (e.g., CCTV).

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Phase 5: Community Handover and Inauguration

- Develop and sign over maintenance plans to the local government and community groups.
- Train municipal staff on the operation and maintenance of new equipment and systems.
- Officially inaugurate the parks and initiate community engagement programs and activities.

Phase 6: Post-Completion Monitoring

- Monitor Park usage, facility conditions, and public satisfaction through surveys.
- Identify any necessary adjustments or corrective maintenance required.

5. Implementing Authority:

- Sindh Government
- Local Government
- Private Investors

6. Estimated Cost

Total Estimated Cost: Rs. 472.26 million (approx.)

6.4.7 Immediate Action Plan for Core Urban Area

Khairpur city, with its rich historical and cultural heritage, has significant potential for enhancing its recreational infrastructure. The city currently faces a lack of well-maintained public spaces, sports facilities, and preserved heritage sites. To address these challenges, an immediate action plan has been developed, focusing on three key projects: transforming vacant spaces into green areas to improve the urban environment, upgradation of the existing parks to improve recreational and community well-being, rehabilitating the Bakhat Ali Dahot Hockey Stadium Luqman to promote sports and youth engagement. The following sections outline the objectives, scope, and immediate actions for each project.

A. Infill of Vacant Spaces for Green Spaces

Objective: To convert underutilized vacant spaces into green areas, enhancing the city's environment, promoting biodiversity, and providing residents with accessible recreational areas.

- Identify strategic vacant spaces within the urban fabric of Khairpur City that can be converted into green spaces.
- Implement landscaping, tree plantation, and installation of seating and recreational amenities.

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- Ensure accessibility and connectivity of green spaces with pedestrian pathways and cycle tracks.
- Initiate plantation drives with community participation.
- Install benches, shaded areas, and public amenities
- Develop an irrigation plan using sustainable water sources such as rainwater harvesting or recycled water.
- Install fencing, lighting, and surveillance systems for security.
- Coordinate with municipal authorities, landowners, and local communities to secure permissions and support for the project.

B. Upgradation of Existing Parks, Khairpur

Objective: Transform the existing parks i.e., Talpur Colony, Dilshad Parks, Bilawal FA Park etc. into a vibrant community hub with improved recreational facilities and cultural activities.

- Repair and widen walking tracks using eco-friendly materials.
- Install modern play equipment, outdoor gym stations, and clean public toilets.
- Upgrade lighting (solar LEDs) and security (CCTV + patrols).
- Introduce themed sections (medicinal plant garden, picnic zones).
- Construct a small amphitheatre for cultural events and public gatherings.
- Organize weekly activities (yoga classes, storytelling sessions, environmental workshops).
- Partner with schools for "Park Clean-Up Days" and tree-planting drives.

C. Rehabilitation of Bakhat Ali Dahot Hockey Stadium Luqman

Objective: To restore and upgrade the Bakhat Ali Dahot Hockey Stadium Luqman into a fully functional facility that promotes physical activity, youth engagement, and community well-being.

- Renovate and upgrade existing sports facilities including football, hockey, and basketball courts.
- Upgrade washrooms, locker rooms, and drinking water facilities.
- Install new lighting and drainage systems for improved usability.
- Introduce a youth sports program and community engagement activities.
- Organize sports events, tournaments, and awareness programs.
- Collaborate with local schools and colleges to encourage youth participation.
- Deploy security personnel and install CCTV cameras for safety.
- Develop a routine maintenance schedule for long-term facility management.

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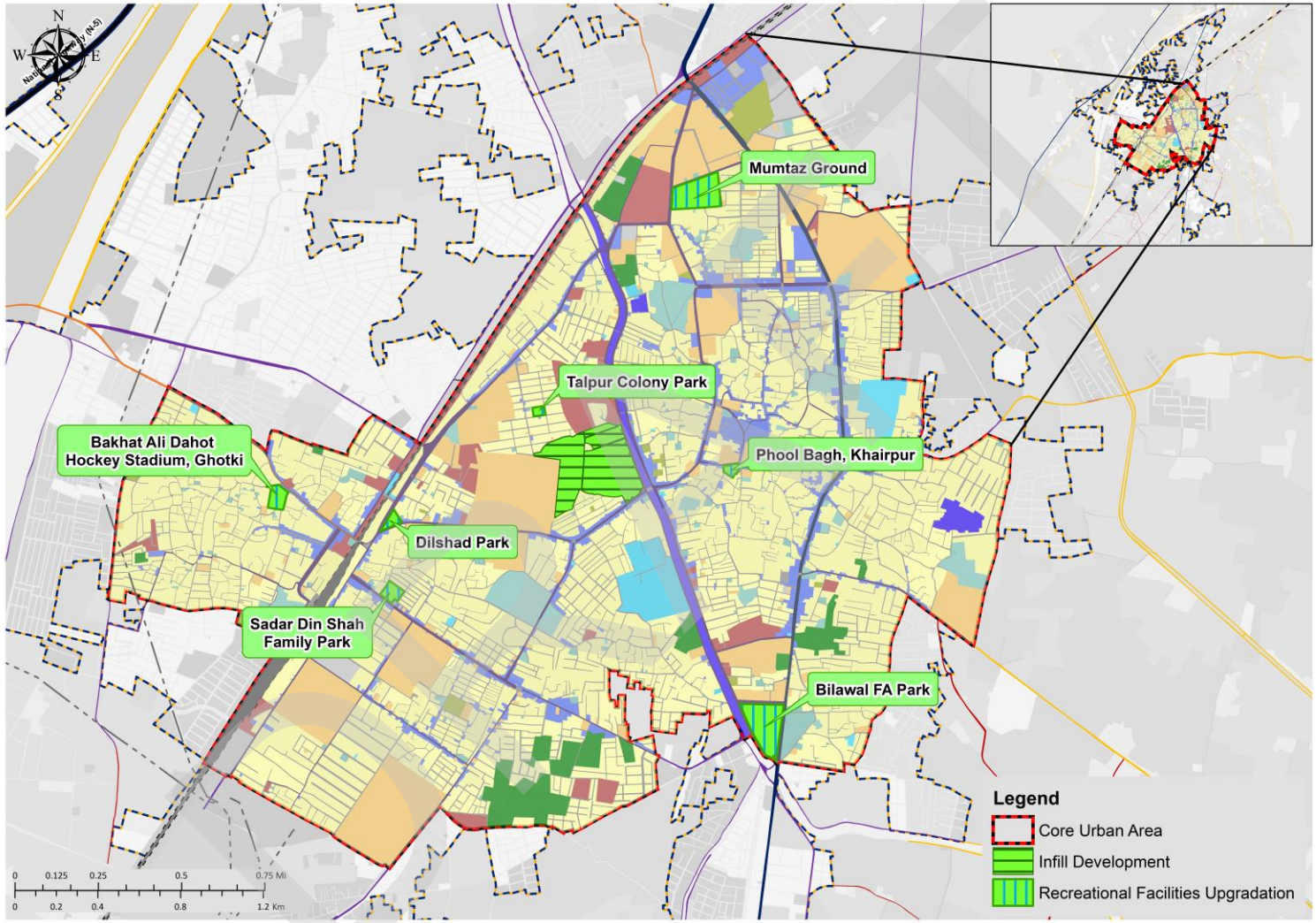


Figure 6-16, Recreational Facilities in Core Urban Area – Khairpur

Source: *The Consultant Team*

SECTION - 7: ECONOMIC DEVELOPMENT PLAN

7.1 Introduction

Khairpur city's economic growth hinges on the sustainable development of its key sectors includes agriculture, livestock, fisheries, industries, and commerce, which form the backbone of local livelihoods and regional trade. This section evaluates the current economic landscape, identifies constraints such as limited infrastructure, market access, and technological gaps, and proposes strategic interventions to enhance productivity, diversify the economy, and foster inclusive growth, positioning Khairpur as a thriving economic hub.

7.2 Agriculture

7.2.1 Existing Situation

The agricultural sector is the mainstay of the economy of Khairpur, with about 61% of the population engaged in it. The city is also known as the " City of Dates ", while Sindh as a whole produce 85% of Dates within Pakistan, though dates have never been cultivated with any commercial enthusiasm. Along with dates, the district produces substantial yields of rice, wheat, cotton, sugarcane, and mangoes. Given the rich soil and critical agro-climate, productivity in agriculture is low due to traditional ways of farming, limited mechanization and poor marketing linkages. The Mirwah and Rohri canals play a vital role in irrigation and low rainfall forms an essential element in the water scarcity. Lack of supportive infrastructures viz. storage, cold chains, processing units are also limiting factors for agricultural economy.

7.2.2 Key Issues and Challenges

Agriculture in Khairpur is confronted by several systemic and structural issues. These range from inefficient irrigation systems (which lead to water losses), poor access to modern farming inputs (eg quality seeds and fertilizers) and to a lack of agricultural credit and extension services. Farmers grapple with pests, particularly the bollworm in cotton and fruit flies in mangoes. Large amount of post-harvest losses is due to lack of organized marketing channels and processing plants. Farming monocultures of crops, in particular date overreliance, expose farmers to both market and climate shocks. In the North in particular, groundwater salinization and water-logging are evident as a result of inadequate drainage.

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7.2.3 SWOT Analysis

Strengths	Weaknesses
• Khairpur has fertile land, leading in date production, all type of agri-purpose land available	• Poor irrigation system • Primitive farming practices • Inefficient pest and disease management.
Opportunities	**Threats**
• Opportunities to diversify into high value crops like mangoes, citrus and vegetables • Improve agro-processing and access national and export markets.	• Climate change • Shrinking availability of water, pests • Ebb and flow of global markets that may impact commodity and farming income.

7.2.4 Need Assessment

To bring the agriculture to the modern era and to increase production, it is necessary to increase the water use efficiency by improved irrigation systems like sprinkler and drip system. Farmers need increased access to good quality inputs, credit, and technical advice. Diversifying into high-value crops is now a matter of priority to reduce dependence on staples and to strengthen resilience. Investments in agro-processing infrastructure and marketing systems are needed to allow farmers to generate better incomes through processing. Farmer cooperatives are one means for smallholders to gain improved access to inputs, credit and markets.

7.2.5 Strategic Development Plan

The approach is a more holistic one that addresses productivity as well as profitability. It encourages progressive farming techniques such as climate-resilient seed varieties, usage of farm machinery, IPM, and laser land levelling. The document, in response to water scarcity, proposes restoration of canals and creation of solar-based tube wells and better methods of irrigation. It promotes diversification of crops, and an emphasis on mangoes, citrus, bananas, onions and pulses, with appeal for establishment of demo farms and farmer field schools. Agro-Processing is the other area of interest particularly for dates and mangoes and modern processing units are being proposed to be set up in the Khairpur Special Economic Zone (KSEZ). The plan further stresses the need to promote contract farming, improving post-harvest management, and consolidating farmer groups.

7.2.6 Priority Projects

A number of high-profile projects are proposed. They involve revitalizing of agricultural extension services, subsidizing the use of drip and sprinkler irrigation equipment, and rehabilitating essential irrigation facilities including

the Mirwah canal. There's also a move to set up state-of-the-art date processing units, cold storage, and packaging centers in the KSEZ to supplement income and enhance exports. "Promote diversification of crops through quality sapling distribution, training and formation of farmers' societies," the order said. Guarantee schemes will improve access to credit, while crop insurance regimes are to shield farmers against climate or market related financial shocks.

7.3 Livestock

7.3.1 Existing Situation

Livestock is an integral component of the rural economy in Khairpur, providing, on average, nearly one-third of the agricultural revenue and is an important source of livelihood, food, and income security for farming households [26]. The district accounts for around 493,000 cattle, 528,000 buffalo 901,000 goats and 109,000 sheep in the latest livestock census. There are also over 600 commercial poultry farms in the area, which are involved in both the production of meat and eggs. Notwithstanding this remarkable resource base, livestock activities are still predominantly traditional and subsistence-based, characterized by weak productivity, little commercialism, and marginal participation in formal markets. The industry has a high potential for growth through modernization, value addition, and better animal health facilities.

7.3.2 Key Issues and Challenges

The livestock potential of Khairpur is fraught with a variety of constraints. These limitations include poor accessibility to veterinary services, low availability of quality feed, inferior genetic potential of animals and unorganized markets. Resources are limited, with too few veterinary clinics and insufficient trained personnel to provide those clinics/animals with proper care. Little or no preventive medicine, vaccination and modern husbandry are available to most of livestock owners. In addition, the lack of processing facilities and cold chains result in postharvest losses, especially in the dairy industry. In addition, productivity is hampered by seasonal feed shortages, most pronounced during the dry season.

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7.3.3 SWOT Analysis

Strengths	Weaknesses
• Large livestock population and good rural knowledge of the animals.	• Traditional practice • Low milk and meat production • Inadequate veterinary attention • Lack of value chain alignment
Opportunities	**Threats**
• Commercial dairying and meat production • Breed improvement programme • Processing and marketing facilities	• Livestock diseases • Scarcity of feed • Variations in the local climate and limited market access

7.3.4 Need Assessment

The livestock sector needs to be unlocked by commercializing dairy and meat production, enhancing veterinary services and facilitating value chain development. 190Investing in breed improvement using artificial insemination, opportunities for good quality feeding and disease control campaigns is crucial. Dairy processing and meat processing plants (along with cold chains and chilling centers) would have to be set up so that the producers are able to get better value for their produce. Moreover, the industry needs specific support for women and smallholders in charge of backyard livestock as well as community-based organizations and cooperatives for concerted action and resources.

7.3.5 Strategic Development Plan

The policy in livestock development is to migrate from a subsistence-oriented system to a commercial oriented one. It suggests that a state-of-the-art dairy processing plant be developed through PPP (public-private partnership) to pasteurize milk and make yogurt and cheese. Village-based milk chilling centers will be established for quality retention in collection. In meat, feedlots and fattening farms will be encouraged and meat plants will be built to service local and export markets. Veterinary care will be increased through new hospitals, mobile vet units and inoculation drives. Programs will be launched for the training of animal husbandry even as women farmers will be given greater empowerment. The sponsors will also provide breeding programmes, feed supplementation and community fodder banks.

For poultry, it will seek to upgrade existing farms and help make available better feed and breeds, as well as building a poultry processing unit. The Fisheries Department will provide technical support for fish farming to be started in the areas scientifically suited for it such as where the land is waterlogged or close to the canals. The district also seeks to develop livestock farmer cooperatives to facilitate collective marketing and credit and feed access.

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7.3.6 Priority Projects

Prioritized projects are: Dairy Processing Plant, Milk Chilling Centers and a Modern Meat Processing Unit. There will be investment in developing breeds, in expansion of veterinary services and in vaccination. A new Bakra Mandi will be constructed at National Highway to enable animal-free trade with proper facilities. Complementary activities such as poultry and fish production, and enabling policies for cooperatives and access to credit may also be considered in the implementation strategy. These initiatives are intended to promote productivity, raise rural incomes, and formalize the livestock economy in Khairpur.

7.4 Fisheries

7.4.1 Existing Situation

Due to the geographical situation fisheries are not a major job providing sector of Khairpur. The area is not rich in its natural fishing base as there are no large rivers or any coasts in the district. Nonetheless, the potential for inland aquaculture, especially in waterlogged or canal-irrigated areas has to be exploited and expanded. Availability of underutilized pond, stagnant waters and saline soil in some areas also poses opportunities for fish Culture in this district. Though relatively small in scale today, fisheries may offer an additional source of income for rural families and contribute to food security and employment potentials if appropriately developed.

7.4.2 Key Issues and Challenges

The fisheries in Khairpur are not well developed due to problems such as lack of awareness, a shortage of technical knowledge, and lack of fish farming infrastructure. No fish feed, fingerlings or technical advice are available in a system of supply. There are also no model projects, that would encourage and motivate enterprises of local farmers to produce aquaculture. There is little market access for fish, and limited institutional support from local fisheries authorities.

7.4.3 SWOT Analysis

Strengths	Weaknesses
• Availability of waterlogged land and canal water; interest in income diversification among the farmers.	• Non-existent fish farming industry or trained personnel • Lack of education.
Opportunities	**Threats**
• Inland culture of fish (tilapia, carp) could be introduced to fishable water bodies • Support from fisheries departments • Possibility of integrating aquaculture into existing production systems	• Lack of water, poor water quality, lack of veterinary support for aquaculture, human fear or resistance due to being new.

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7.4.4 Need Assessment

In order to start fisheries sector, the district requires small/ pilot scale aquaculture farms showing possibility and profitability. The technical education of farmers, the supply of fingerlings and feed, and the construction of small size pond infrastructures are also needed. Site selection, water quality and good practice need to be supported by the Fisheries Department. Community-level support institutions, like cooperatives or producer groups, would assist smallholder farmers to operate differently as a group and gain better access to markets.

7.4.5 Strategic Development Plan

Introduction of inland aquaculture as the new source of livelihood is stressed in fisheries development plan. It suggests the utilization of unused/underused ponds and low-productive lands along canals to develop small-scale fish culture ponds. Farmers will similarly be assisted technically in conjunction with the provincial Fisheries Department. Carp and tilapia, fish that can cope with changing conditions and grow quickly, will be promoted. Pond management, feeding and harvesting and pigeon supply management training will be organized. Interactions with other sectors—such as the utilization of waste from livestock to feed fish, or aquaculture integrated with horticulture—will be promoted to foster sustainability. It also involves exploring the value chains of activities in fish drying, packaging, and small island distribution to ensure profitability.

7.4.6 Priority Projects

Priority activities are government- or donor-funded pilot fish farming projects, staff training, and support programs. Experiments in using canal or stagnant water for aquaculture will be introduced in certain villages. Maihandua Fish Value Chain: Support for construction of fish ponds, input support (fish seed/feed) and linking to market for selling fresh fish. Fish farming is the successful entrenched activity of the rural economy of Khairpur which aims for fish farming to be fully integrated and developed, providing income diversification, enriched nutrition and resource conservation.

7.5 Industries

7.5.1 Existing Situation

However, the industrial activity in Khairpur is low, dominated by agro based and cottage industries. It also contains two sugar mills, about nine date-processing factories, eleven cotton ginning factories, and some rice and flour mills. There is also a cottage industry element, such as handicrafts and textiles. Gambat taluka has a small Industries Estate and there is no any large industrial estate in Khairpur city. The inauguration of Khairpur Special

Economic Zone (KSEZ) is a significant milestone in the direction of industrialization by providing modern infrastructure and an ideal location in close proximity to key agricultural areas and highways. But still so much capital and development investment has not even got near to being reached.

7.5.2 Key Issues and Challenges

Principal barriers to industrial growth include poor infrastructure, limited access to finance and skilled employees, red tape, and inadequate investment promotion. SMEs encounter obstacles to obtain permits, electricity and water connections. There are inadequate training facilities which are also non-industry based and this has led to a shortage of technically skilled manpower. Furthermore, the infrastructure that gets the raw materials to the highways is in bad shape as well, which hurts logistics and the supply chain.

7.5.3 SWOT Analysis

Strengths	Weaknesses
• Nearness to the agriculture market centers and agro based industries, infrastructure of KSEZ and availability of abundant labor.	• Lack of industrial infrastructure, low reliability of power and gas, and skilled manpower.
Opportunities	**Threats**
• Growth of KSEZ, SME growth, vocational education and PPPs to boost FDI.	• Bureaucratic administrative procedures, no investor incentives and regional competition by more developed zones.

7.5.4 Need Assessment

Khairpur has to be developed as an industrial centre for which there is an immediate requirement of investment in infrastructure, utilities, training, etc. as well as facilitation of business activities. KSEZ is to be completed and operationalized, along with feeder roads, logistic hubs, and utility enhancements, accelerated. It is necessary that the new mini-industrial estates and the already established Gambat Small Industries Estate should be developed for the promotion of SMEs. Vocational and technical schools must be overhauled to produce the labour market required for agro-processing, engineering, textiles and the fastest-growing sectors.

7.5.5 Strategic Development Plan

The strategy centers on developing industrial zones like KSEZ, improving road and utility infrastructure, and aligning skill development with industrial

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demand. KSEZ, with its 140-acre site and guaranteed power, water, and gas, is positioned as the industrial nucleus. Incentives such as tax breaks and one-window approvals will be offered to attract investment. Simultaneously, the Small Industries Estate in Gambat will be upgraded, and land for a new industrial estate near Khairpur city will be acquired. A logistics park and truck terminal will support goods movement. To address the skill gap, technical

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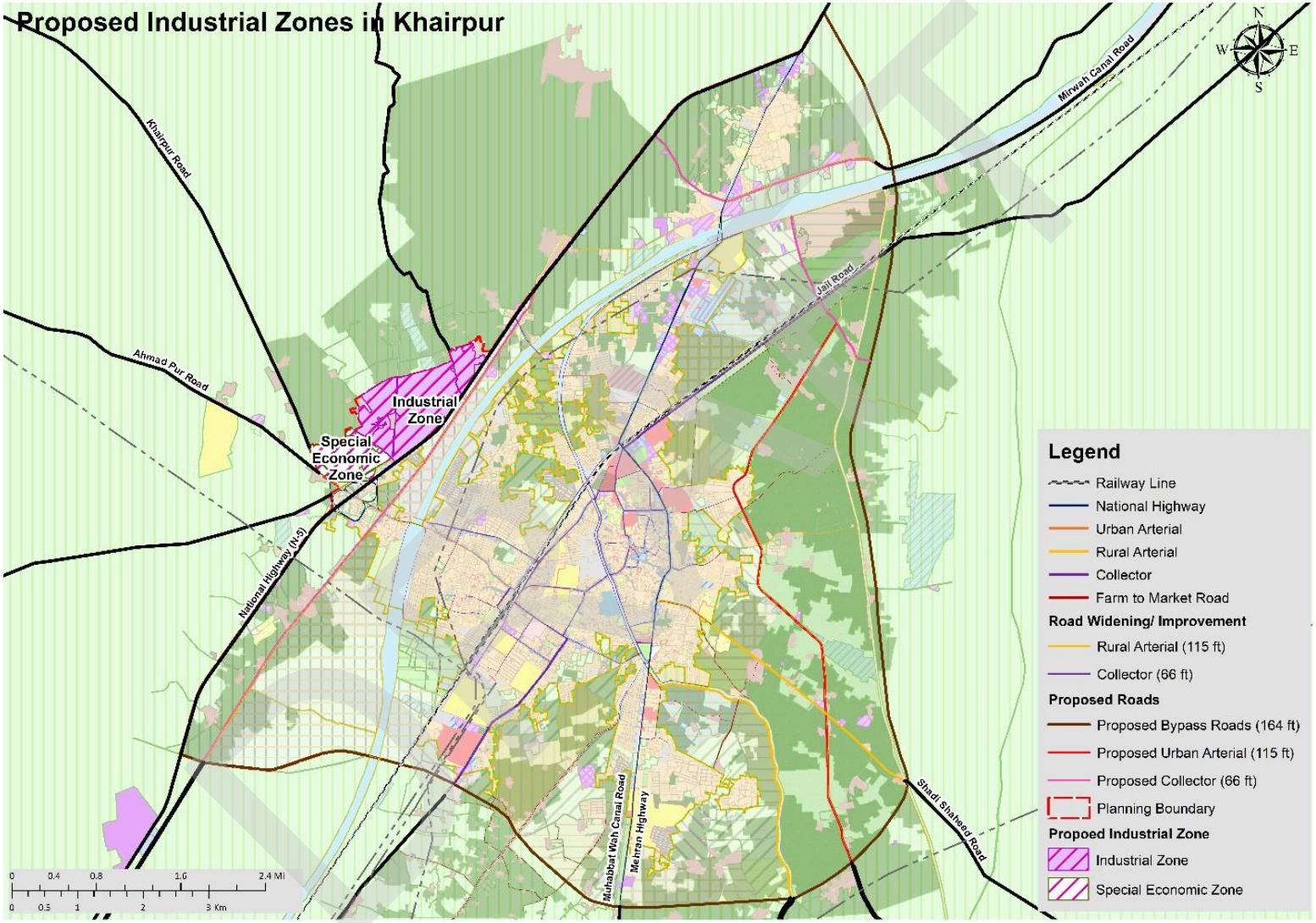


Figure 7-1, Proposed Industrial Zones in Khairpur

Source: *The Consultant Team*

training centers will be expanded, and curricula updated in collaboration with local industries. The plan also proposes youth-focused entrepreneurship initiatives and promotion of women-led businesses. The following figure shows the spatial distribution of proposed land uses related to Industry.

7.5.6 Priority Projects

Priority projects in the schemes include the infrastructure development of the KSEZ, upgradation of the Small Industries Estate, Gambat, construction of a mini-industrial estate and the revamping of the power and gas supply systems. Also planned are a logistics hub, truck terminal and vocational training centers. Facilitations including a Business Incubation Centre and Investment Promotion Cell will be extended to start-ups. The blueprint will create at least 50 new industries in Khairpur within next 5–7 years that will open up several thousands of jobs as well as reduce the reliance on agriculture.

7.6 Trade and Commerce

7.6.1 Existing Situation

Khairpur is strategically situated along trade routes, including the National Highway N-5 and the busiest railway line which links the province of Sindh with Punjab. However, despite this favorable condition, trade and commerce is not very advanced, because of infrastructure bottleneck, lack of market integration. Agricultural products, notably dates and mangoes, are the key traded products of the region, however, value chains are weakly organized and there is inadequate post-harvest infrastructure. There is very limited presence of modern wholesale markets, storage or export-oriented platforms, and local producers get low returns. The district is disadvantaged, too, by the lack of logistics services and processing units that, if present, would have the potential of increasing trading volume.

7.6.2 Key Issues and Challenges

Key challenges were attributed to inadequate farm to market roads, inadequacies in modern mandi infrastructure, lack of cold storage and packaging facilities and insufficient integration with national or international markets. Its district lacks a dry port or container terminal to take advantage of export cargo. Local entrepreneurs are hampered by the bureaucratic backlog and paucity of efficient business processes, while foreign investors are deterred. Besides, weak digital infrastructures suppress e-commerce and limits producers from linking up the larger markets.

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7.6.3 SWOT Analysis

Strengths	Weaknesses
• Strategic location, large agricultural base and good connectivity through roads and railways.	• Weak market infrastructure, low logistics • Non-existent export credit and bureaucratic bottlenecks
Opportunities	**Threats**
• Creation of new markets and storage capacities • Integration in regional and global value chains and digital trade platforms	• Competition from more established trade hubs • Risks from climate-induced changes to transport and storage • Varying export regulations.

7.6.4 Need Assessment

To enhance trade, the trade and commerce of Khairpur need huge investment in physical and digital infrastructure. The farm-to-market roads have to be improved for transportation and lower losses. (P) Setting up a modern grain and date market with associated cold storage, grading and auctioning arrangements is inevitable for transparency and efficiency in pricing. Better digital infrastructure will help local products, including dates and handicrafts, nest online platforms. Key methods of facilitating exports, including a dry port feasibility study, food certification center, and logistics support, have a direct bearing on market entry and competitiveness.

7.6.5 Strategic Development Plan

The trade plan prioritizes construction of physical infrastructure, unifying value chains and creating an investor-friendly climate. Primary initiatives are the widening of National Highway N-5, expansion of the farm-to-market road system, and upgrading of roads to the Kandhkot–Ghotki bridge. The proposed grain and date market, near Khairpur city, with facilities of grading, cold storage and packaging plants, will act as hub of the local trading network. A logistics park and dry port are planned to facilitate the transport of goods and generate export-led investment. The strategy would also promote a digital market of agro-products and handmade crafts in Khairpur to bring the producers closer to the buyers from the country and the world. Regulatory changes and public-private dialogue will help to improve business conditions, and export branding and trade fairs will help to sell Khairpur internationally. The following figure shows the spatial distribution of proposed land uses related to commerce.

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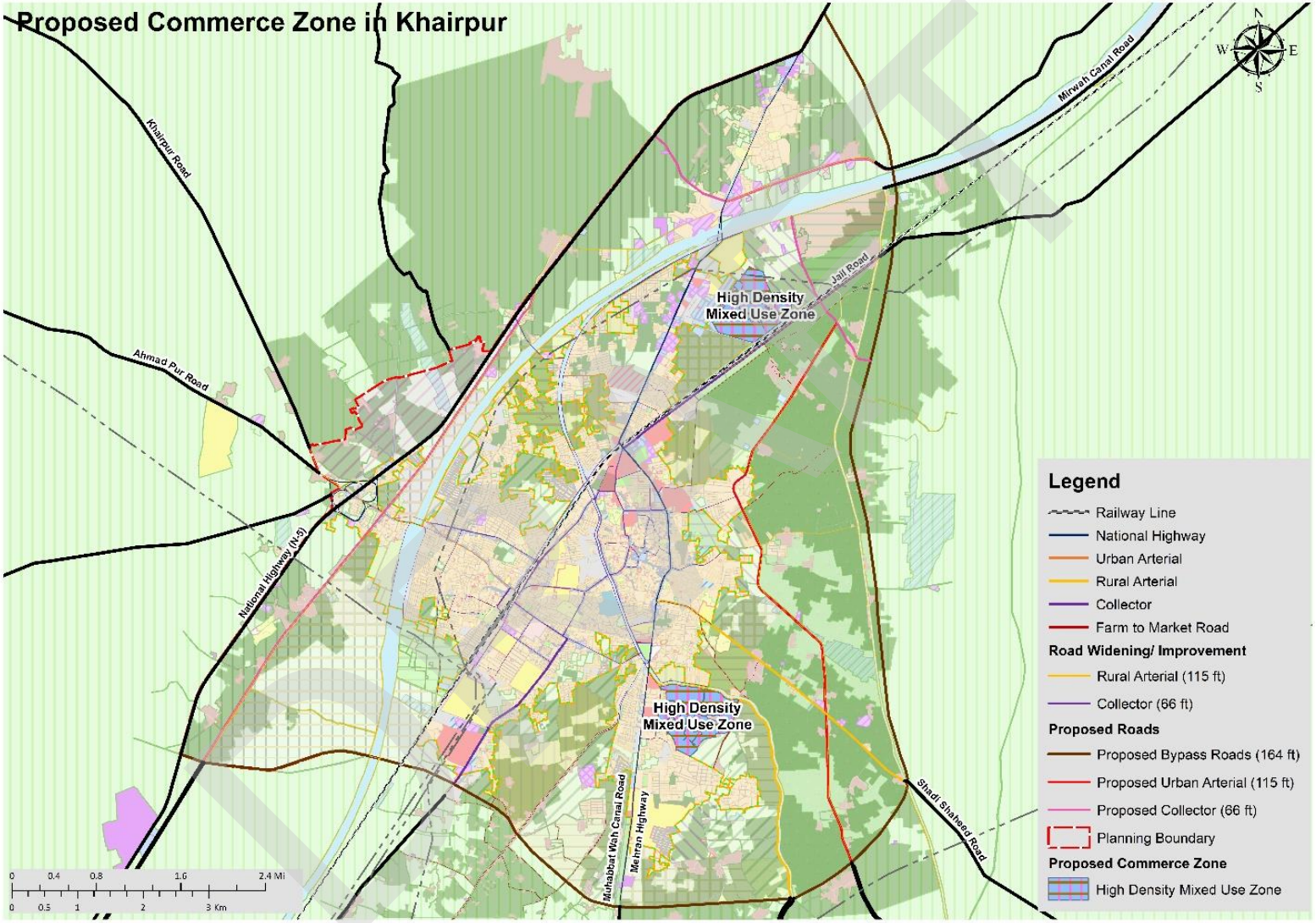


Figure 7-2, Proposed Commerce Zones in Khairpur

Source: *The Consultant Team*

7.6.6 Priority Projects

Some of the priority projects are to upgrade farm-to-market roads and highways, build a modern grain and date mandi, establish cold storage and packaging centers, and explore the feasibility of a dry port. Other two things that are high on the agenda are creation of a food certification center and logistics node within the KSEZ. With a view of facilitating market access, the digital infrastructure will be strengthened and an online market place will be initiated for local products. Export facilitation desk will support traders for customs, documentation and availing of incentives. Khairpur Competitiveness & Livelihood Improvements This project aims to making Khairpur a competitive trading hub using its agricultural riches and transport connections. The following figure shows the spatial distribution of proposed land use related to science park.

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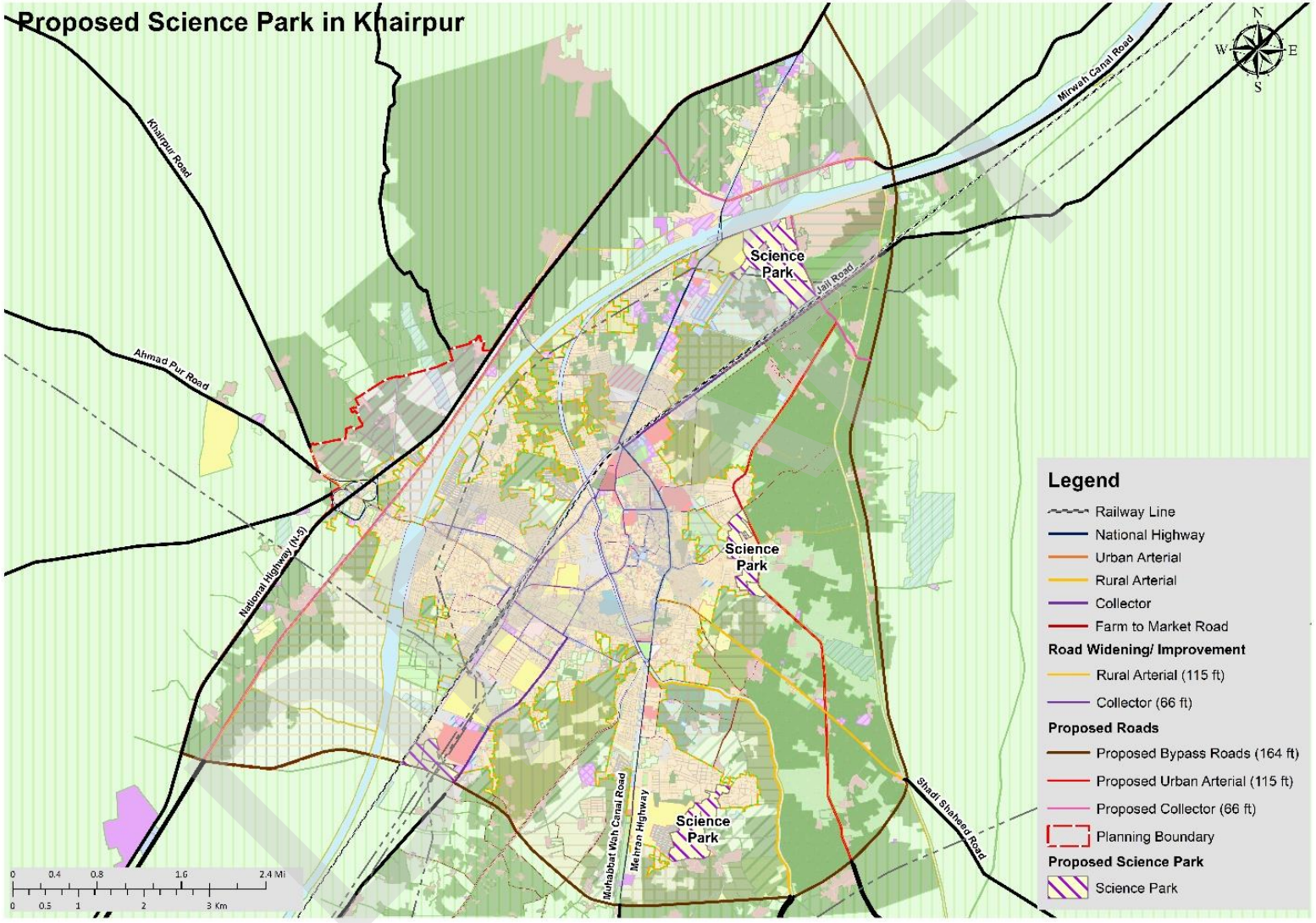


Figure 7-3, Proposed Science Park in Khairpur

Source: *The Consultant Team*

7.7 Financing Strategy and Resource Mobilization

The Economic Development Plan (EDP) recognizes that successful implementation hinges on the availability of financial resources. To that end, the following resource mobilization strategy will guide investments:

7.7.1 Public Sector Funding

- **Annual Development Program (ADP):** Core government funding via Sindh ADP, covering infrastructure, vocational training, agriculture, and urban services.
- **Federal Programs:** Targeted projects through federal PSDP (e.g., roads, M-6 linkage, SEZ support).
- **Line Department Budgets:** Each lead agency will align EDP targets with their annual allocations.

7.7.2 Donor and Development Partner Support

- Mobilize funding from multilateral agencies like World Bank, Asian Development Bank, USAID, and UNDP for sectors like water, sanitation, climate resilience, skills, and SME support.
- Propose PPP-based infrastructure and service delivery pilots through donor-supported grants (e.g., solid waste, renewable energy, vocational training).

7.7.3 Public-Private Partnerships (PPP)

Leverage Sindh PPP Unit to structure:

- Industrial Estate development
- Dairy and agro-processing plants
- Cold chains and logistics hubs
- Wastewater treatment

Offer fiscal incentives and long-term land leases to attract private investors to these PPPs.

7.7.4 SME and Startup Finance

- Partner with SMEDA, SEDF, and commercial banks to expand SME loan schemes.
- Link youth and women entrepreneurs with Kamyab Jawan, BISP entrepreneurship program, and Akhuwat microfinance.

7.7.5 Municipal Revenues

Strengthen local revenue through:

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- Improved property tax collection (in coordination with Excise Dept.)
- Market fees and user charges (grain market, parks, etc.)
- Lease/sale of industrial plots within designated zones

7.7.6 Investment Promotion Mechanisms

The Investment Promotion Cell will:

- Package bankable investment projects for pitching to investors
- Maintain a pipeline of priority projects
- Facilitate investor licensing, approvals, and aftercare

7.8 Social Inclusion and Equity Strategy

The EDP places inclusive growth at its core by prioritizing the economic and social empowerment of marginalized groups, especially women, youth, persons with disabilities (PWDs), and low-income communities. Equity-focused development ensures that the benefits of growth reach the most vulnerable segments of society.

7.8.1 Strategic Actions for Inclusion:

A. Women's Economic Empowerment

- Establish women-only vocational centers offering training in tailoring, embroidery, IT, and food processing.
- Create 10 women self-help groups (SHGs) in Phase 1 for collective enterprise and micro-loans.
- Prioritize women-led enterprises for SME loans under BISP, SEDF, and microfinance.
- Ensure at least 30% female participation in all training and employment programs.
- Improve safety in public spaces (e.g., streetlighting, women-friendly transport) to enable access to work.

B. Youth Engagement and Employment

- Train over 1,000 youth (40% women) in trades like solar repair, construction, IT, and agro-processing.
- Establish youth business incubator hubs in partnership with SMEDA and private firms.
- Facilitate apprenticeships and internships with local industries and municipal departments.
- Promote youth leadership in EDP oversight through representation in community monitoring groups.

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C. Support for Low-Income Households and PWDs

- Ensure geographic equity by targeting underserved neighbourhoods for early infrastructure upgrades (water, roads, parks).
- Provide free or subsidized vocational training for BISP and Zakat-eligible families.
- Design public buildings and infrastructure to be disability-friendly (ramps, signage).
- Partner with NGOs to deliver targeted services for PWDs and out-of-school youth.

D. Gender and Inclusion Governance

- Assign a Gender & Inclusion Focal Point within the EDP Implementation Committee.
- Conduct annual audits on equity outcomes (e.g., % of women/youth beneficiaries).
- Involve local women's organizations and youth councils in project design and feedback.

7.9 Public-Private Partnerships (PPP) and Investment Facilitation

Khairpur needs this amount of development which cannot be done through public sector hence Public-Private Partnerships and private investment are key. Also, establishing infrastructure projects through public-private partnership (PPP) models is part of the governance framework. The dairy processing plant, industrial estate development or solar power project could, for example, be done as PPPs where the government offers land or partial financing and private sector, investment and expertise. Such deals can also be structured transparently with the help of guidance from the Sindh PPP Unit. The plan also calls for a "Khairpur Economic Development Board" to be made up of official, local business leaders, prominent farmers and chamber of commerce representatives.

This board can handle investor issues, raise opportunities, and assist in accelerating decisions. As indicated in the Industrial section, Investment Promotion Cell at the district level will act as a one-window facilitator for investors to guide them through permits and licenses in order to eliminate red-tapism. A tax concession for the industries of less developed districts (lower electricity tariff or provincial tax breaks for initial years). The district administration would pursue any policy support from the provincial government that may be required. docx). Digitization of land records and business registration at the district level are among efforts to ease bureaucratic hassles so that investors don't waste time in administrative hoops. Khairpur can realize such large projects (SEZ build-out, major infrastructure) which otherwise may not be feasible through public funds alone, by establishing an investor-friendly environment and using private capital to suit through PPPs.

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7.9.1 Engagement and Transparency

A key paradigm is to give a voice to the people of Khairpur in the development process by allowing them to benefit from it. We will fulfill this promise by developing a governance model that will institutionalize community participation in broad range of initiatives. For instance, Community Based Organizations (CBOs) or Citizen Community Boards, which has been in action in Khairpur, and executed projects with the local government involved in assessment to even performing minor project work. The plan puts forward the idea of forming advisory groups for each main sector – a District Agriculture Board made up of progressive farmers, an Industrial Liaison Committee comprising local entrepreneurs, etc, which can advise officials and conduct on-ground review of the progress. Village committees will be engaged in operation and maintenance of rural water supply schemes or monitoring school development which promotes local ownership.

On transparency the use of technology will be enhanced: a public dashboard of development projects can be established (visible at the DC office or upload on internet) including allocation of funds, status of projects and their outcomes so that citizens can track progress. We will hold regular public forums or town hall meetings in which the DC and officials present updates on the EDP implementation and citizens can ask questions – this holds the process accountable and builds trust. In the same vein, the grievance redressal mechanism at the district also needs to be made more robust, whereby complaints related to service delivery or corruption are taken up and addressed in a timely manner. In fostering communities and transparency, governance becomes bi-directional, thus improving the success and sustainability of projects.

7.9.2 Reforms in Regulation and Policy Support

To achieve some goals of the EDP, changes in policy or local regulations may be needed. The district administration will work with the provincial government to review and reform the regulations that are an impediment for economic activity. Session was informed. For example, agriculture produce markets act local market regulations should be relaxed to allow farmers' direct markets or contract farming, so that farmers would be able to sell produce. The city may need to update building codes and land use rules to carry out the urban plan to guarantee new construction is done according to zoning and safety standards).

In the industrial field, the environmental laws will be implemented in letter and spirit no industry can start without Sindh EPA etc. but at the same time the procedures like EPA clearance or other NOCs will be fast-track through one-window cell in Khairpur to avoid long delays. Local authorities shall provide information through print, social & digital media on the fiscal incentives (if any

i.e. under SEZ Act in case of KSEZ) available to businesses. The district will also seek more development funding from the provincial ADP by demonstrating readiness and good planning; and possibly getting special packages for critical infrastructure. Policy supports also involves integrating this EDP into the provincial planning framework, which informs future budgets and donor-funded programs. There might be a need to strengthen the legal framework of PPPs at the district level to bring confidence to private partners. In sum, refamiliarize yourself with the longer and deeper changes to come with necessary regulatory tweaks and enabling policies to position the plan.

7.10 Monitoring and Evaluation (M&E)

The monitoring & evaluation system will be strict and will closely monitor the effectiveness of EDP and the results achieved. A specialized M&E unit could be created within the DC office to aggregate data regarding key indicators (e.g., crop yields, new SMEs created, jobs created, infrastructure built, etc.). Specific Responsibilities Oversight of the progress of the EDP and the preparation of biannual progress reports on the EDP. These will use tools such as GIS mapping for the project locations and possibly a dashboard visible to stakeholders. Each sector will have at least one KPI (key performance indicator) established at the beginning; for example, increases in agricultural yield by X%, placement of a number of vocational trainees, the number of households without clean water, etc.

Monitoring would not just be quantitative but qualitative, seeking feedback (from farmers, entrepreneurs, citizens) on whether the interventions are effective or not. Periodic reviews (another 2-3 years) will be conducted to see what's working, what's not working and course corrections – this is adaptive governance. M&E needs to be open too: disseminating findings publicly can enhance accountability. Ultimately, a robust M&E mechanism ensures that the plan remains on track, overcoming any implementation bottlenecks and helping "move the plan from paper to the ground", and ensuring measurable success.

7.10.1 Timing and Phasing of Implementation

As the EDP need to be introduced in several phases with defined milestones to roll-out the initiatives, Year 1-2 quick-win projects will set the stage (rehabilitation of one significant road, launching vocational training program, initiating pilot drip-irrigation sites) .Talk of transformative change may sound vague and distant, but it is often something that can be held to account: By Year 3-5, larger infrastructures like the dairy plant or industrial estate upgrade should be underway or completed, governance reforms institutionalized, and mid-term targets met (such as Farmers trained in new practices >50%, greater availability of skilled workers) . In Years 6-10, we will focus on consolidation and scaling up successful interventions (expanding

what worked, improving or replacing what didn't) and enabling the local institutions to keep the momentum going well beyond the project period. Below is a summary of the implementation timeline:

Table 7-1, Key Initiatives and Targets

Phase	Timeframe	Key Initiatives and Targets
Quick Start	Year 1 – 2	• Launch farmer training (500 farmers in modern practices) • Rehabilitate 50 km of watercourses for irrigation • Set up Investment Promotion Cell and one-window facilitation • Begin Khairpur city road improvements (at least one major artery) • Initiate vocational training for 200 youth (with 30% women) • Form DPDC and sector working groups for plan oversight
Acceleration	Year 3 – 5	• Complete new Small Industrial Estate (Gambat) upgrade 50% operationalization of KSEZ (basic infrastructure ready, first factories built) • Establish dairy processing plant and 5 milk collection centres • Achieve 20% increase in average wheat/cotton yields through interventions • Create 5 new cold storage/packhouse facilities for dates & mangoes • Reduce urban water supply gaps by 50% (new wells/tanks built)- Place 1,000 trained youth into jobs or self-employment
Consolidation	Year 6 – 10	• KSEZ at full capacity with diverse industries (100% plots allotted)- Khairpur exports of dates and agro-products increased by 50% • Livestock: 25% increase in milk collection, new meat processing unit operational- All villages have access to vet services and improved seeds/pesticides supply • Urban services: 24/7 water supply in Khairpur city, functional sewage treatment plant • Poverty rate significantly lowered (target: youth unemployment <10%) • Robust local institutions managing development, ensuring sustainability

This phased approach, coupled with the governance measures above, will

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ensure that the Economic Development Plan for Khairpur is implemented in a structured, accountable manner. By engaging stakeholders at every step and making mid-course adjustments as needed, Khairpur's journey towards a prosperous, inclusive, and sustainable economy will stay the course. With strong political will and community support, Khairpur can emerge as a model of rural-urban integrated development in Sindh, leveraging its agricultural wealth, entering new industrial horizons, and improving the quality of life for all its residents. The foundations laid by this plan will enable Khairpur's economy to grow robustly and resiliently for years to come.

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SECTION - 8: BASIC UTILITIES

8.1 Introduction

Basic utilities, including water supply, sewerage and drainage, and solid waste management, are fundamental to ensuring public health, environmental sustainability, and liability in Khairpur city. This section assesses the current state of these utilities, identifies key challenges such as inadequate infrastructure and service gaps, and proposes strategic interventions to enhance service delivery, improve sustainability, and support Khairpur's long-term urban development strategy.

8.2 Water Supply

8.2.1 Existing Situation

Water Supply System of Khairpur city is based on surface and ground water resources. A slow sand filtration plant capacity of 0.5 MGD is using Surface water of Mirwah canal and a large number of tube wells have been installed on the bank of Mirwah and Rohri canal to extract fresh subsoil water. After treating the surface water through sand filters is mixed with the ground water of tubewells and then it is transported to OHRs or directly to the consumers. In some areas tubewells are also directly transporting water supply to consumers.

A. Water Resource

1. Tubewells along Canal

There are two available sources of fresh water for the Khairpur city. One is the Mirwah canal and second is Rohri canal. Public Health Engineering Department (PHED) has installed tubewells for water supply along the bank of canals, their operation and maintenance are carried out by Municipal committee of Khairpur. Two surface treatment plants are also installed along Mirwah canal. One treatment plant is functional and has a design capacity of 0.5 MGD. The other is very old and non-functional.

85 tubewells are installed along the bank of both canals. 77 tubewells are installed along Mirwah Canal and 8 tubewells are installed along Rohri Canal. Tubewells installed along Mirwah canal has the design capacity of 1 cusec each on Mirwah canal but the actual capacity varies with the condition of pump. Tubewells installed along Rohri canal have the design capacity of 0.25 cusec each.

During field survey, it was observed that out of 85 tubewells, 45 nos. tubewells are functional, 26 nos. are non- functional due to burnt motor or absence of pumping machinery, while 14 nos. of tubewells have been abandoned owing to failure of bores. Along Rohri Canal, there are 08 tubewells; 04 tubewells are functional, 03 tubewells are Non-Functional and 01 is abandoned. The remaining 77 tubewells have been installed along Mirwah Canal but only 41 tubewells are in operation. Detailed summary of Tubewells is attached as **Table** 8-1.

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Table 8-1, Details of Existing Tubewells

Source	No of Tubewells	Capacity Each (Cusec)	Total Capacity (cusec)	No of Tubewells		
				Functional	Non-Functional	Abandoned
Mirwah Canal	77	01	77	41	23	13
Rohri Canal	08	0.25	2	04	03	1
Grand total	85	-	78.5	45	26	14

Source: *The Consultant Team*

2. Surface Water Treatment Plant

At present, two treatment plants exist in Khairpur. These treatment plants are installed along Mirwah canal. Out of these two treatment plants, one is functional (Khakhee Shah) and other is abandoned (Phase-V). The treatment plant which is functional has the production capacity of 0.5 MGD. It has three pump stations which pump the treated water to the distribution system. The summary of these pump stations is given below.

Table 8-2, Summary of Pump Stations at Surface treatment plant

Pump No.	Pump Type	Capacity (Cusec)	Status	Motor HP	Working Hours
Pumping Station-01					
1	Centrifugal	1	Functional	60	8
2	Centrifugal	1	Functional	60	8
3	Centrifugal	1	Functional	60	8
4	Centrifugal	1	Non-Functional	60	-
5	Centrifugal	1	Non-Functional	60	-
6	Centrifugal	1	Non-Functional	60	-
7	Centrifugal	1	Non-Functional	60	-
Pumping Station-02					
1	Centrifugal	1	Functional	60	8
2	Centrifugal	1	Non-Functional	60	-
3	Centrifugal	1	Functional	60	8
4	Centrifugal	1	Non-Functional	60	-
5	Centrifugal	1	Non-Functional	60	-
6	Centrifugal	1	Non-Functional	60	-
7	Centrifugal	1	Non-Functional	60	-
Pumping Station-03					
1	Centrifugal	1	Non-Functional	60	-
2	Centrifugal	1	Non-Functional	60	-

Source: *The Consultant Team, 2023*

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B. Adapted Water Demand

Currently there is no defined criteria is available as national level except National reference manual, but different department has produced their own criteria in their serving areas. However, considering the fresh availability in Pakistan, we have taken **30 GPCD** (imp gallons) for domestic water consumption. This figure is used to calculate the current demand of the city for reference keeping other running projects in Pakistan regarding water supply. This figure will be revised when the design criteria will be finalized on the later stage of the project. Non-domestic demand includes commercial and institutional demands.

C. Population Projection

Population density method is used to calculate total number of persons in one zone.

Percentage of area occupied by one zone is calculated then multiplied by total population to get number of persons in that specific zone.

The methodology for Population projection is added in the report. Further population projection is corresponding to the land use and master planning concept. Similar values and population density is adopted for calculation of population up to the draft strategic planning horizon, priority planning and immediate action plan for calculating the loads and demands of the utilities proposed on the master planning.

D. Total Production Capacity of Khairpur

Keeping in view, the existing tubewells and surface treatment plant capacity, total production capacity of Khairpur is calculated below in **Table** 8-3**.**

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Table 8-3, Production capacity of functional tubewells Khairpur City

Source	No of Tubewells	Capacity Each (Cusec)	Total Capacity (cusec)	No of Tubewells			Daily Water Production (Cusec)	
				Functional	Non-Functional	Abandoned	Present with 12 hours pumping	Possible with 16 hours pumping
Mirwah Canal	77	01	77	41	23	13	20.50	27.33
Rohri Canal	08	0.25	2	04	03	1	0.5	1
Grand total	**85**	**-**	**79**	**45**	**26**	**14**	**21.00**	**28.00**
Total production from Tubewells (GPD)							**11,301,898**	**15,069,197**
Total Production from WTP (GPD)							**500,000**	**500,000**
Total Production (GPD)							**11,808,898**	**15,569,197**
Present population within MC (2023)								191,044
Possible water Available per capita per day (GPCD) @ 12 hours								61.78
Possible water Available per capita per day (GPCD) @ 16 hours								78.88
Present population of the city within Urban Extent (2023)								263,645
Possible water Available per capita per day (GPCD) @ 12 hours								44.76
Possible water Available per capita per day (GPCD) @ 16 hours								57.16

Source: *The Consultant Team, 2023*

Available water making non-functional tubewell to functional is given in the **Table** 8-4.

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Table 8-4, Available water making non-functional tubewell to functional

Source	No of Tubewells	Capacity Each (Cusec)	Total Capacity (cusec)	No of Tubewells			Daily Water Production (Cusec)	
				Functional	Non-Functional	Abandoned	Present with 12 hours pumping	Possible with 16 hours pumping
Mirwah Canal	77	01	77	41	23	13	32	42.67
Rohri Canal	08	0.25	2	04	03	1	0.88	1.17
Grand total	**85**	**-**	**79**	**45**	**26**	**14**	**32.88**	**43.83**
Total production from Tubewells (GPD)							**17,692,852**	**23,590,469**
Total Production from WTP (GPD)							**500,000**	**500,000**
Total Production (GPD)							**18,192,852**	**24,090,469**
Present population of MC (2023)								191,044
Projected population of MC (2043)								340,387
Possible Available Water per capita per day @12 hours per day (2023)								95.23
Possible Available Water per capita per day @12 hours per day (2043)								53.45
Present population of the Urban Extent (2023)								263,645
Projected population of the Urban Extent (2043)								469,742
Possible Available Water per capita per day @12 hours per day (2023)								69.01
Possible Available Water per capita per day @12 hours per day (2043)								38.73

Source: *The Consultant Team, 2023*

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E. Demand Gap

Gap analysis is done on the basis of water availability from current sources. The detail calculations are given below in the **Table** 8-5 and **Table** 8-6**.**

Table 8-5, Demand Gap Analysis for Population within MC

Year	Population Of MC	Water Demand (cusec)	Available Capacity of Functional WTP	Available capacity (cusec) with functional tubewells and WTP	Demand Gap (cusec)	Available capacity (cusec) after rehabilitation of non-functional tubewells	Demand Gap (cusec)
2023	191,044	14.0	0.93	22.86	8.83	33.80	19.77
2028	220,721	16.2	0.93	22.86	6.65	33.80	17.59
2033	255,008	18.7	0.93	22.86	4.13	33.80	15.07
2038	294,621	21.6	0.93	22.86	1.22	33.80	12.16
2043	340,387	25.0	0.93	22.86	(2.14)	33.80	8.80

Table 8-6, Demand Gap Analysis for Population within Urban Extent

Year	Population Of MC	Water Demand (cusec)	Available Capacity of Functional WTP	Available capacity (cusec) with functional tubewells and WTP	Demand Gap (cusec)	Available capacity (cusec) after rehabilitation of non-functional tubewells	Demand Gap (cusec)
2023	263,645	19.4	0.93	22.86	3.49	33.80	14.44
2028	304,600	22.4	0.93	22.86	0.49	33.80	11.43
2033	351,916	25.8	0.93	22.86	(2.99)	33.80	7.96
2038	406,583	29.9	0.93	22.86	(7.00)	33.80	3.94
2043	469,742	34.5	0.93	22.86	(11.64)	33.80	(0.70)

***Note**: Values in the brackets are the negative values.*

***Source:** The Consultant Team, 2023*

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F. Water Works (Overhead Reservoirs/Ground Storage Tanks)

The Consultant jointly with MC staff, visited the water works constructed at various locations. There are two water works in Khairpur, and these water works consists of one OHR each. The water is directly pumped to OHRs and then distributed further.

There are two overhead reservoir (OHR) exists in the project area. Detail of Overhead Reservoirs is described in **Table** 8-7**.**

Table 8-7, Detail of OHRs in Khairpur

Sr. No.	Water works	Material	Overhead reservoirs		Year of Construction	Status
			No.	Capacity (gallons)		
1	Shaheed bad	RCC	01	100,000	2013	Functional
2	Dilshad Park	RCC	01	100,000	2013	Functional

Source: *The Consultant Team, 2023*

G. Distribution Network

Water is supplied in Khairpur city through pressure pipe network either by direct pumping method through tubewells or by fill and draw method through OHRs. Existing Distribution Network in Khairpur covers 63% of the municipal boundary of the city. The distribution network comprises of mostly P.E. pipes and a small number of A.C. pipes. Pipe diameters range from 3-inch to 18-inch and total length of the distribution network is around 159 Kms including 3.8 kms of transmission main. The system is operated intermittently (8 to 12 hours per day). Layout map of Existing Distribution Network is given in **Figure** 8-1**.**

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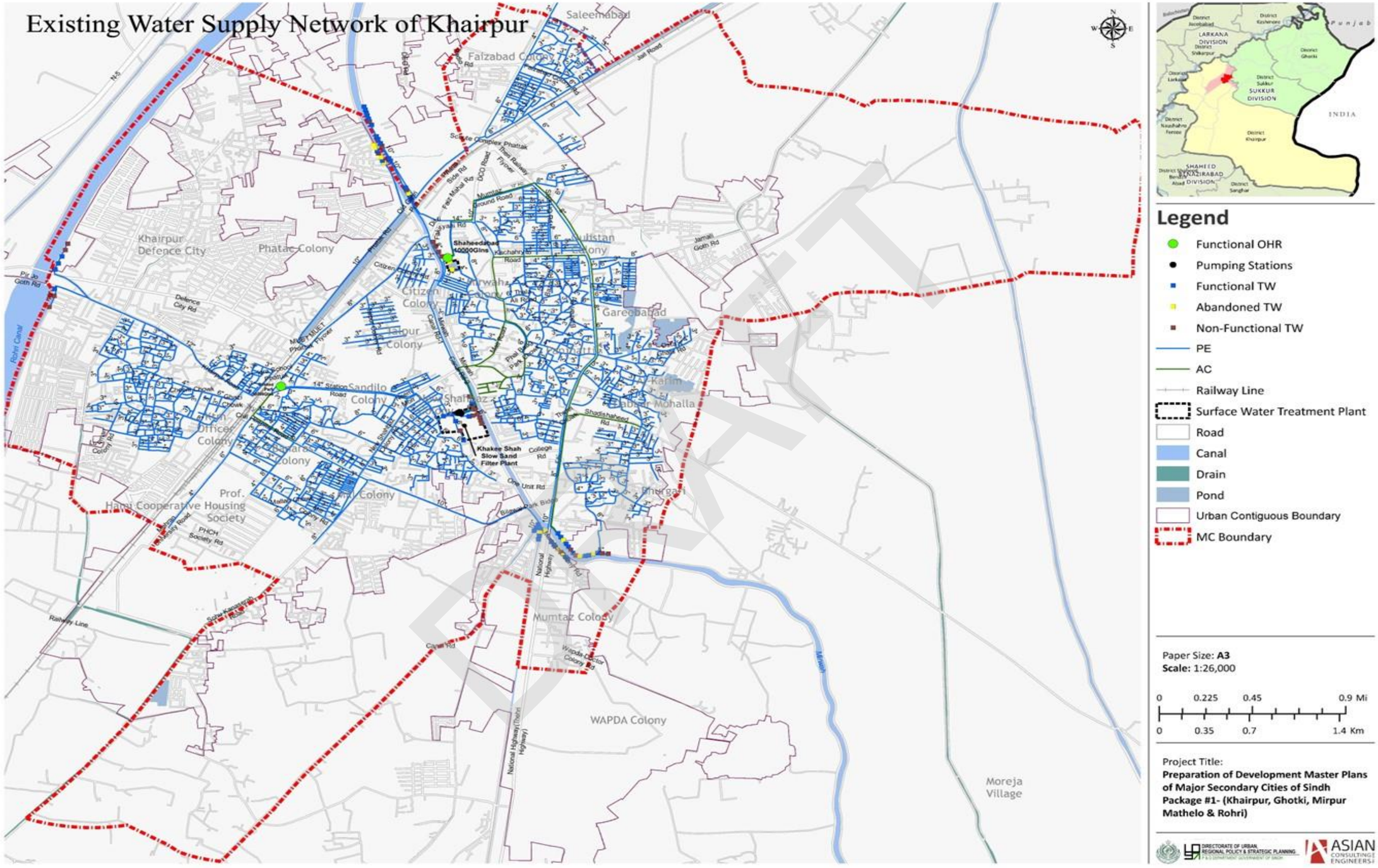


Figure 8-1, Existing Water Supply Network of Khairpur City

Source: *The Consultant Team*

H. Unserved Areas

There are some areas within MC boundary which are not facilitated by water supply system. The inhabitants of this area are relying on groundwater since groundwater is fresh. These areas are either close to the canal or lying in the freshwater zone. The water demand of these areas is increasing day by day. The list of unserved areas is given below:

- Phatac Colony
- Defense City
- Mumtaz Colony
- Wapda Colony
- Alam Khan Gopang
- Channa Goth

I. Key Issues and Challenges

The existing water supply system requires considerable capital investment to bring to appropriate performance standards. This will include investment to install new tube wells and distribution assets.

The existing system has been degraded by age, poor operational practices, and inadequate maintenance. Considerable rehabilitation is required to bring additional assets up to acceptable condition, including works on existing tubewells and the distribution network.

Based on the evidence available, it appears that non-revenue water is a significant issue. This increases the waste of available water, and reduces financial sustainability.

There are also evidence of major operational shortcomings including:

- Bores of some tubewells have been blocked due to which load on adjacent tubewell has been increased which is reducing the pressure in served areas.
- Decades old piped network is more prone to leaks and rusts as many of the pipelines are reported to be old and in poor condition.
- There is no standby generator available at most of tubewells, hence during power outage, water become unavailable.
- MC covers 63% of total area and the remaining area is unserved. They meet the water requirement by individual hand pump/motor pump.
- Pipe leakages is not being resolved timely, caused by Insufficient leak repair capacity (number of teams) and/or lack of funding leading to a long interval between the moment when the leak is known or located and the effective leak repair.

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- No chlorination of water is being done before supplying to consumers. Chlorinator dosing pump is installed at the Khakhee Shah water works, but it is non-functional from longer period of time.
- Insufficient water levels maintained in service tanks causing insufficient flow rates and pressures.
- Limited capability and capacity to identify and resolve illegal connections.
- No metering of water consumption. While this will take some time to implement, at least it should be prioritized to start immediately.

There are no Standard Operating Procedure (SOPs), no operational and maintenance manuals and asset management framework/ plain.

8.2.2 SWOT Analysis

STRENGTHS	OPPORTUNITIES
• Master planning initiated. • Availability of fresh groundwater as resource. • Surface water treatment on Mirwah Canal. • Water supply infrastructure is present. • Water tariffs are collected on monthly basis. • Experienced staff available with the organization related to water supply system.	• Adequate resources of water available for water supply system. • Public private partnership in service delivery.
WEAKNESSES	**THREATS**
• No consumer and bulk metering. • Aged infrastructure nearing end of lifecycle. • No stable pressure/head maintained in the water distribution network. • 64% MC boundary is not covered by piped supply. • The animals do contaminate the surface water source during grazing near the source and drinking water at the source. • Minimal water tariff is unable to sustain operation and maintenance.	• Resistance to pay for water and sewerage services. • Depletion of water quality due to draw down. • System inefficiency and reduced delivery of services. • Contaminated water consumption resulting in the health problems for the residents of the Khairpur.

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8.2.3 Feasibility Analysis

The proposed water supply projects are designed to meet the immediate water demand outlined in the action plans. A detailed analysis has been conducted for the placement and number of tube wells, as well as the required pipeline lengths, to ensure efficiency and effectiveness. The pipe materials and tube well capacities have been selected carefully, keeping in mind both technical requirements and cost considerations. This ensures that the system performs reliably without exceeding budgetary constraints. The overall design maintains a balance between performance and economic viability. In the case of the sewerage system, the pollution load to be managed by the trunk sewers has been thoroughly studied. Routes for the trunk sewers have been selected to avoid excessive excavation depths, which helps reduce construction challenges and costs. The alignment of sewer lines ensures minimal disruption to existing infrastructure and natural terrain. These design decisions contribute to the overall feasibility and sustainability of the project. The proposed systems are practical, efficient, and ready for timely implementation.

8.2.4 Strategic Development Plan

This section describes the detailed design of different components of water supply system till year 2043. Detailed design of water supply system includes:

- Planning concept
- Water sources
- Detailed design of water supply pipe network
- Computer aided hydraulic modelling and analysis of water supply system
- Design of tubewells
- Design of Over Head Reservoirs (OHRs)
- Priority Projects

A. Zoning Criteria

The zoning criteria adopted for water supply is in accordance with the landuse plan provided for all the four cities. The extent of zoning is based on the following factors:

- Topography of the project area.
- Location of the existing water supply network and the transmission mains.
- Location and elevations of the existing and proposed ground and elevated reservoirs.
- Location/use of existing tube wells.
- Present and future population.

The detailed zoning maps corresponding to the exact master planning for the city is provided in **Figure 8-2.**

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B. Planning Concept

According to the Detailed Design of Water Supply of Khairpur City, whole city has been divided into 9 zones to make the water supply operation easy. Each zone has its own serving area. In order to handle water supply maintenance issues, each zone is connected to other. Pumping Stations (PS) have been proposed based upon the demand and population of each zone. The total projected population of year 2043 is 699,173 of Khairpur City and total average demand is 61.63 cusec. The required maximum daily demand is 92.44 cusec.

The layout of these zones has been shown **Figure** 8-4. Population of each zone is presented in the **Table** 8-8. Detail of these zones is given below.

1. Zone-1

The total projected population of Zone 1 for year 2043 is 90,892. The total average demand of Zone 1 is 8.0 cusecs. The required maximum daily demand for 24 working hours and 16 working hours is 12 cusecs and 8.0 cusecs, respectively. The diameters use in this zone range from 82.5 mm to 413.7 mm. The length of pipe of diameter 82.5 mm, 101 mm, 146.8 mm, 206.8 mm, 257.4 mm, 367.7 mm and 413.7 mm is 490,432 ft, 8,817 ft, 29,785 ft, 26,850 ft, 4,141 ft, 79,784 ft and 845 ft respectively. An economical velocity must therefore be chosen for each zone is less than 5 ft/sec. The maximum velocity in this zone is 4.67 ft/sec.

2. Zone-2

The total projected population of Zone 2 for year 2043 is 62,926. The total average demand of Zone 2 is 5.5 cusecs. The required maximum daily demand for 24 working hours and 16 working hours is 8.3 cusecs and 5.5 cusecs, respectively. The diameters use in this zone range from 82.5 mm to 413.7 mm. The length of pipe of diameter 82.5 mm, 101 mm, 146.8 mm, 206.8 mm, 257.4 mm, 367.7 mm and 413.7 mm is 244,685 ft, 3,028 ft, 4,552 ft, 1,610 ft, 3,526 ft, 8,279 ft and 54,116 ft respectively. An economical velocity must therefore be chosen for each zone is less than 5 ft/sec. The maximum velocity in this zone is 4.8 ft/sec.

3. Zone-3

The total projected population of Zone 3 for year 2043 is 111,868. The total average demand of Zone 3 is 9.8 cusecs. The required maximum daily demand for 24 working hours and 16 working hours is 14.8 cusecs and 9.8 cusecs, respectively. The diameters use in this zone range from 82.5 mm to 413.7 mm. The length of pipe of diameter 82.5 mm, 101 mm, 146.8 mm, 165.4 mm, 206.8 mm, 257.4 mm, 367.7 mm and 413.7 mm is 384,747 ft, 22,794 ft, 2,712 ft, 41,688 ft, 26,588 ft, 9,365 ft, and 119,807 ft and 1,452 ft respectively. An economical velocity must therefore be chosen for each zone is less than 5 ft/sec. The maximum velocity in this zone is 4.9 ft/sec.

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4. Newly Proposed Zone-1

The total projected population of Newly proposed Zone 1 for year 2043 is 45,446. The total average demand of Newly Proposed Zone 1 is 4.0 cusecs. The required maximum daily demand for 24 working hours and 16 working hours is 4.0 cusecs and 6.0 cusecs, respectively. The diameters use in this zone range from 82.5 mm to 367.7 mm. The length of pipe of diameter 82.5 mm, 101 mm, 146.8 mm, and 367.7 mm is 88,130 ft, 18,880 ft, 8,920 ft, and 23,412 ft respectively. An economical velocity must therefore be chosen for each zone is less than 5 ft/sec. The maximum velocity in this zone is 4.36 ft/sec.

5. Newly Proposed Zone-2

The total projected population of Newly proposed Zone 2 for year 2043 is 55,934. The total average demand of Newly Proposed Zone 2 is 4.9 cusecs. The required maximum daily demand for 24 working hours and 16 working hours is 11.06 cusecs and 4.9 cusecs, respectively. The diameters use in this zone range from 82.5 mm to 367.7 mm. The length of pipe of diameter 82.5 mm, 146.8 mm, and 367.7 mm is 139,392 ft, 8,505 ft, and 72,709 ft respectively. An economical velocity must therefore be chosen for each zone is less than 5 ft/sec. The maximum velocity in this zone is 4.84 ft/sec.

6. Newly Proposed Zone-3

The total projected population of Newly proposed Zone 3 for year 2043 is 59,430. The total average demand of Newly Proposed Zone 3 is 5.2 cusecs. The required maximum daily demand for 24 working hours and 16 working hours is 7.8 cusecs and 5.2 cusecs, respectively. The diameters use in this zone range from 82.5 mm to 367.7 mm. The length of pipe of diameter 82.5 mm, 146.8 mm and 367.7 mm is 180,570 ft, 178,679 ft, 3,439 ft and 36,689 ft respectively. An economical velocity must therefore be chosen for each zone is less than 5 ft/sec. The maximum velocity in this zone is 4.85 ft/sec Future Proposed Zone-1

The total projected population of Future proposed Zone 1 for year 2043 is 69,917. The total average demand of Future proposed Zone 1 is 6.1 cusecs. The required maximum daily demand for 24 working hours and 16 working hours is 9.2 cusecs and 6.1 cusecs, respectively. The diameters use in this zone range from 367.7 mm to 459.7 mm. The length of pipe of diameter 367.7 mm and 459.7 mm is 2,182 ft, and 14,045 ft respectively. An economical velocity must therefore be chosen is between 6-8 ft/sec for rising mains. The maximum velocity in this zone is 6.13 ft/sec.

7. Future Proposed Zone-2

The total projected population of Future proposed Zone 2 for year 2043 is 55,934. The total average demand of Future proposed Zone 2 is 4.9 cusecs. The required maximum daily demand for 24 working hours and 16 working hours is 7.4 cusecs and 4.9 cusecs, respectively. The diameters use in this zone is 459.7 mm. The length of pipe of diameter 459.7 mm is 22,927 ft. An economical velocity must therefore be chosen is between 6-8 ft/sec for rising mains. The maximum velocity in this zone is 5.28 ft/sec.

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8. Future Proposed Zone-3

The total projected population of Future proposed Zone 3 for year 2043 is 146,826. The total average demand of Future proposed Zone 3 is 12.9 cusecs. The required maximum daily demand for 24 working hours and 16 working hours is 19.4 cusecs and 12.9 cusecs, respectively. The diameters use in this zone is 413.7 mm. The length of pipe of diameter 413.7 mm is 13,591 ft. An economical velocity must therefore be chosen is between 6-8 ft/sec for rising mains. The maximum velocity in this zone is 3.79 ft/sec.

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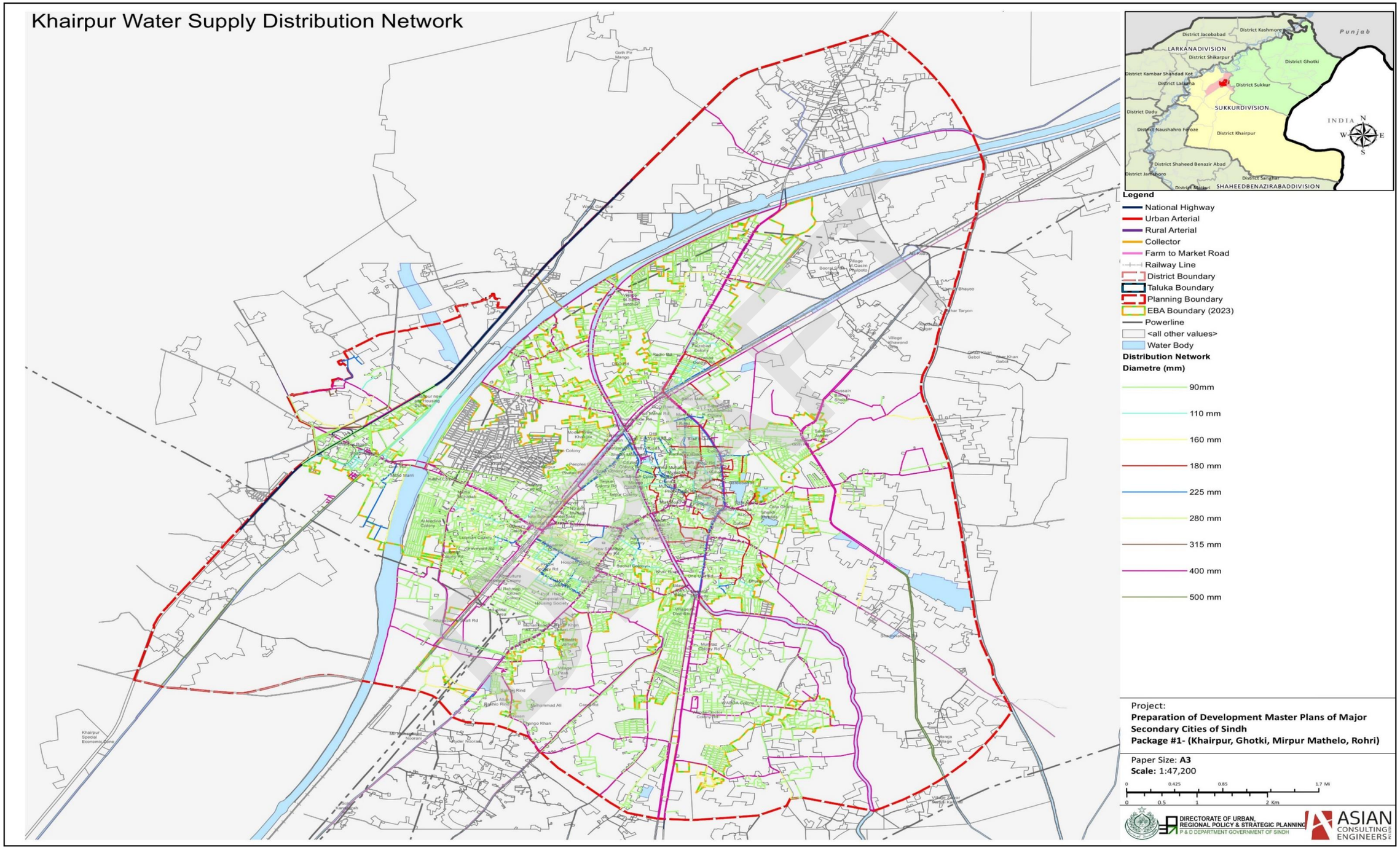


Figure 8-2, Water Supply Distribution Map of Khairpur

Source: *The Consultant Team*

Table 8-8, Population of Each Zone

Zone	Current Population	Projected Population
	2023	2043
Zone-1	57,394	90,892
Zone-2	39,735	62,926
Zone-3	70,639	111,868
Newly Proposed Zone-1	28,697	54,446
Newly Proposed Zone-2	35,320	55,934
Newly Proposed Zone-3	37,527	59,430
Future Proposed Zone-1	44,150	69,917
Future Proposed Zone-2	35,320	55,934
Future Proposed Zone-3	92,714	146,826
Total Population	**441,495**	**699,173**

C. Water Demand

Total water demand for the project area is calculated on the basis of design criteria as discussed in in **Immediate Action Plan (IAP)** Report; Section 3, Heading No.**3.4.3 (Design Criteria for Water Supply)**. Based on the agreed criteria, water demand of the city is estimated in **Table** 8-9.

Table 8-9, Total Average Water Demand of 2043

Zones	Projected Population	Domestic Water Demand	Non-Domestic Water Demand (20% of Domestic)	UFW (10% of avg)	Total Average Water Demand
	2043	(GPD)	(GPD)	(GPD)	(GPD)
Zone-1	90,892	3,272,112	654,422	392,653	4,319,188
Zone-2	62,926	2,265,336	453,067	271,840	2,990,244
Zone-3	111,868	4,027,248	805,450	483,270	5,315,967
Newly Proposed Zone-1	54,446	1,636,056	327,211	196,327	2,159,594
Newly Proposed Zone-2	55,934	2,013,624	402,725	241,635	2,657,984
Newly Proposed Zone-3	59,430	2,139,480	427,896	256,738	2,824,114
Future Proposed Zone-1	69,917	2,517,012	503,402	302,041	3,322,456
Future Proposed Zone-2	55,934	2,013,624	402,725	241,635	2,657,984
Future Proposed Zone-3	146,826	5,285,736	1,057,147	634,288	6,977,172
Total	**699,173**	**25,170,228**	**5,034,046**	**3,020,427**	**33,224,701**

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Based on the above calculations;

Average Water Demand	=	33224701 GPD
	=	61.5 Cusec
Maximum Day Demand	=	61.5*1.5
	=	92.2 Cusec
Peak Demand	=	92.2*1.5
	=	138.3 Cusec

D. Quality of Water Source

The tube well (Ground water source) is adopted in the project city Khairpur City. So, The ERS and Water quality studies of the areas reflect that the Fresh water zone must be chosen for tube well design and lesser values of TDS and Chemical parameters should be encountered in the planning. Chlorinators should be installed at the proposed and existing tube wells for the safe delivery of water.

E. Bore Log Test

Bore log points are being identified and tests are being performed. The detailed bore log report is annexed in the Draft Strategic Planning Report.

F. Tubewells

On the basis of above recommendation, recharge water along the canals will be used for future demand of the city.

As per total demand of water, calculation for the tubewells is shown in **Table** 8-10**.**

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Table 8-10, Calculation of Tubewells

Zones	Projected Population	Total Average Water Demand	Maximum Day Demand		No. of Tubewells		
	2043	(GPD)	GPD	Cusec	Tubewells required to fulfil the demand		
					1 cusec	Existing TWs	Proposed TWs
Zone-1	90,892	4319188	6478782	12	18	10 (3)	36
Zone-2	62,926	2990244	4485365	8.3	13	22	
Zone-3	111,868	5315967	7973951	14.8	22	6	18
Newly Proposed Zone-1	54,446	2159594	3239391	6.0	9	(5)	
Newly Proposed Zone-2	55,934	2657984	3986976	7.4	11	24	6
Newly Proposed Zone-3	59,430	2824114	4236170	7.8	12	18	
Future Proposed Zone-1	69,917	3322456	4983684	9.2	14	0	
Future Proposed Zone-2	55,934	2657984	3986976	7.4	11	0	
Future Proposed Zone-3	146,826	6977172	10465757	19.4	29	0	
Total	**699,173**	**33224701**	**49837051**	**92.20**	**139**	**85**	**60**

Based on the above calculation, we have proposed 92 new tubewell of 1.0 cusec and 99 Nos. tubewell of 0.5 Cusec. It is observed that most of the zones have existing functional tubewell to balance the demand but in some zones, total 12 Nos. existing tubewells are non-functional which required to be repair. Details of tubewells are given in the **Table** 8-11.

Table 8-11, Detail of Tubewells

Khairpur	No. of Tubewells @ 1 Cusec				No. of Tubewells @ 0.25 Cusec			Total proposed
	Functional	Non-functional	Abandoned	Proposed	Functional	Non-functional	Abandoned	
Total	41	23	13	60	4	3	1	60

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1. Design of Tubewell

Capacity and design of tubewell including pump setting depth, size of strainer etc is provided in groundwater study. As per ground water study report, capacity of proposed Tubewell is 0.5 and 1 Cusecs with pump setting depth of 120 ft.

For 0.5 Cusec Capacity

Table 8-12, Design of Tubewell (0.5 cusec)

Capacity of Tubewell	0.5 Cusec
Water Table	120 Feet
Height of OHR	75 Feet
Terminal head	5 Feet
Drawdown	20 Feet
Internal Diameter of Strainer	10-inch
Length of Strainer	96 Feet
Entrance Velocity	0.05 ft/sec
Open area of strainer	10%
Total Head	**220 Feet**

Sizing of Strainer are given in **Table** 8-13.

Table 8-13, Sizing of strainer for 0.5 cusec pump

Sizing of Stainer:			
Tube well capacity	=	0.5	cusec
Entrance velocity of water	=	0.05	ft/sec
Internal diameter of strainer	=	10	inch
Slot area	=	10	% of total strainer area.
Total surface area of strainer	=	π DL x 10	
Area of slots	=	100	
	=		
L	=	Length of strainer	
D	=	Diameter of strainer	
	=		
Q	=	A x V	
Q	=	0.1	X π DL X
L	=	76	
Assuming 25% factor of safety			
L	=	1.25 X	76
L	=	96	ft

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For 1 Cusec Capacity

Table 8-14, Design of Tubewell (1.0 cusec)

Capacity of Tubewell	1 Cusec
Water Table	120 Feet
Height of OHR	75 Feet
Terminal head	5 Feet
Drawdown	20 Feet
Internal Diameter of Strainer	10-inch
Length of Strainer	96 Feet
Entrance Velocity	0.05 ft/sec
Open area of strainer	10%
Total Head	220 Feet

Sizing of Strainer are given in **Table** 8-13.

Table 8-15, Sizing of strainer for 1 cusec pump

Sizing of Stainer:			
Tube well capacity	=	1	cusec
Entrance velocity of water	=	0.05	ft/sec
Internal diameter of strainer	=	10	inch
Slot area	=	10	% of total strainer area.
Total surface area of strainer	=	π DL x 10	
Area of slots	=	100	
	=		
L	=	Length of strainer	
D	=	Diameter of strainer	
	=		
Q	=	A x V	
Q	=	0.1	X π DL X
L	=	76	
Assuming 25% factor of safety			
L	=	1.25 X	76
L	=	96	ft

G. Overhead Water Reservoir

Overhead Reservoirs (OHRs) are also key component of water distribution system. In water supply system OHRs serve the following functions:

- Store water for use during electric load-shedding and during maintenance works of tube-wells/ pumps.
- Provide balancing of flow and pressure during peak hours.

Storage Capacity of Overhead reservoirs should be based on around **1/10th** of average day demand.

Based on average water demand of the project area, required storage is calculated in **Table** 8-16 and layout of OHR location is shown in **Figure** 8-3**.**

Table 8-16, Calculation of OHRs

Zones	Projected Population	Total Average Water Demand	OHRs				
	2043	(GPD)	Existing	Proposed (Gallons)			Total
Zone-1	90,892	4319188	100,000	-	150,000	200,000	3
Zone-2	62,926	2990244	-	100,000	100,000	100,000	3
Zone-3	111,868	5315967	100,000	100,000	150,000	200,000	4
Newly Proposed Zone-1	54,446	2159594	-	100,000	150,000	-	2
Newly Proposed Zone-2	55,934	2657984	-	100,000	150,000	-	2
Newly Proposed Zone-3	59,430	2824114	-	100,000	-	200,000	2
Future Proposed Zone-1	69,917	3322456	-	100,000	150,000	100,000	3
Future Proposed Zone-2	55,934	2657984	-	100,000	100,000	100,000	3
Future Proposed Zone-3	146,826	6977172	-	200,000	250,000	250,000	3
Total	**699,173**	**33,224,701**	**200,000**				**25**

Based on above calculation, we required total 25 OHRs. Additional new 12 OHRs of 100,000 Gallons, 5 OHRs of 150,000 Gallons, 4 OHRs of 200,000 Gallons and 2 OHRs of 250,000 Gallons capacity are proposed 2 from existing is functional in Zone 1 and Zone 3.

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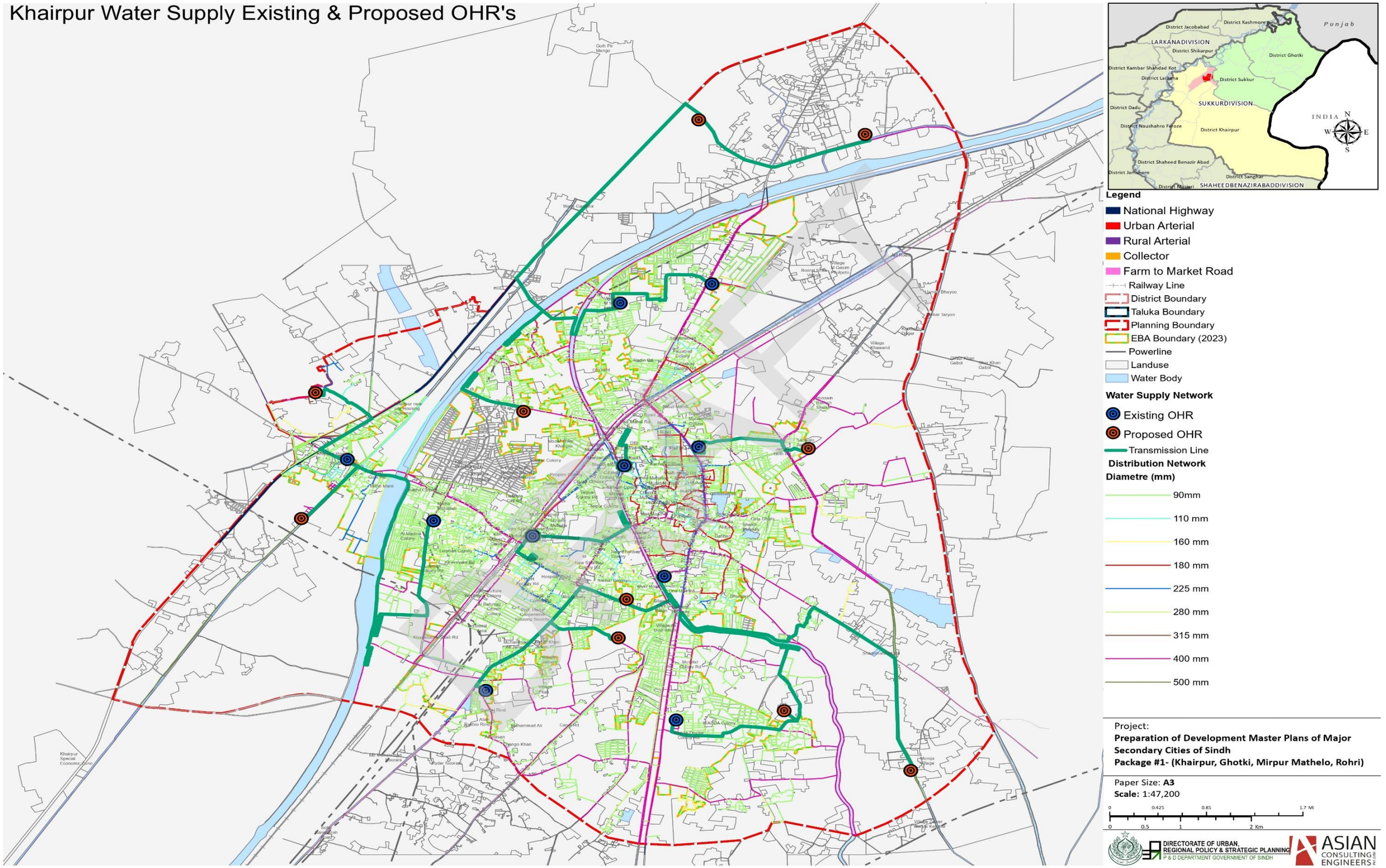


Figure 8-3, Location Plan of Existing and Proposed OHR's

Source: *The Consultant Team*

1. Proposed Planning for Water Supply Network:

Considering the proposed water supply network, water demand for each pipe is calculated based on the feeding/ serving area of the pipe, population and per capita water demand. The water demand of the pipe is primarily based on feeding area. Afterwards, each feeding area is multiplied with respective population resulting in the served population on that pipe. Subsequently, the served population is multiplied with per capita demand to calculate the water demand of each pipe. Water Distribution network is designed to carry the peak water demand of the project area.

Each zone has its independent OHRs to work efficiently but all zones are interconnected with each other through main grid line, which will be used in case of water shortage in any zone or maintenance tenure of OHRs.

Based on the peak hour demand, hydraulic modelling is done in computer software, WATER GEM.

2. Type of Network

There are two types of system that can be used for the designing of water supply network:

- Looped Water Supply System
- Isolated or branched Water Supply System

Looped Water Supply System	Isolated or branched Water Supply System
In this type of system there are several pathways that the water can flow from the source to the consumer. In this system multiple pipes would provide water supply to consumers even if one source is disturbed, water from other pipe would provide the requisite water supply	In isolated system is similar to that of a tree branch, in which smaller pipes branch off larger pipes throughout the service area, such that the water can take only one pathway from the source to the consumer. In this system only one pipe would provide water supply to consumer. In case of any disturbance in source, water supply will be stopped
It is the most widely used configuration in large municipal areas.	This type of system is most frequently used in rural areas.
This system provides a high degree of reliability Whenever a damage to line occurs the damaged line can be isolated with little impact on consumers outside the immediate area	Damage to main line at the start can result in disturbance of whole area
Looping in this system reduces some of the problems associated with water stagnation, such as adverse reactions with the pipe walls, and it increases fire-fighting capability	In this case when tube well will be switched off water will get stagnant in water pipes. Moreover, water hammer can occur due to abrupt change in pressure will occur when tube well will be switched on again.

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Looped Water Supply System	Isolated or branched Water Supply System
In integrated system all the lines in network along with OHRs are interconnected	In isolated system one network of lines having one or more OHRs are disconnected with other networks.
Pressure can be balance	Pressure balance is difficult

On the basis of above comparison, looped system is considered for design of water distribution network. In this system, better pressure can be maintained and repair and Maintenance will be easy.

3. Computer Aided Hydraulic Modelling and Analysis of Water Supply System

In order to analyse and evaluate the proposed water supply network, computer aided hydraulic modelling has been carried out using Water GEMS.

The proposed distribution network does not fulfil the demand considering only existing tube wells and OHRs, therefore overall model is required for the detail design horizon by including the overall additional tube wells and OHRs.

Total Planning Area is divided into different zones to efficiently manage the water supply network as shown in **Figure** 8-4.

As per design criteria, computer model is run to cater the peak flow. Advantages of this scenario is:

- The system is evaluated against peak flows. Therefore, pipes are sized to cater the peak demand in the system.
- The pressures in the system are adjusted for the peak hours.

In this model, the water supply system is analysed for peak hour demand. Key features of model are;

- 25 Nos. OHRs are used for modelling, 02 Nos. Existing and 22 Nos. Proposed.
- Minimum diameter for distribution network is kept as 82.5mm (03 inch) while maximum diameter comes out 459.7 mm (18 Inch).

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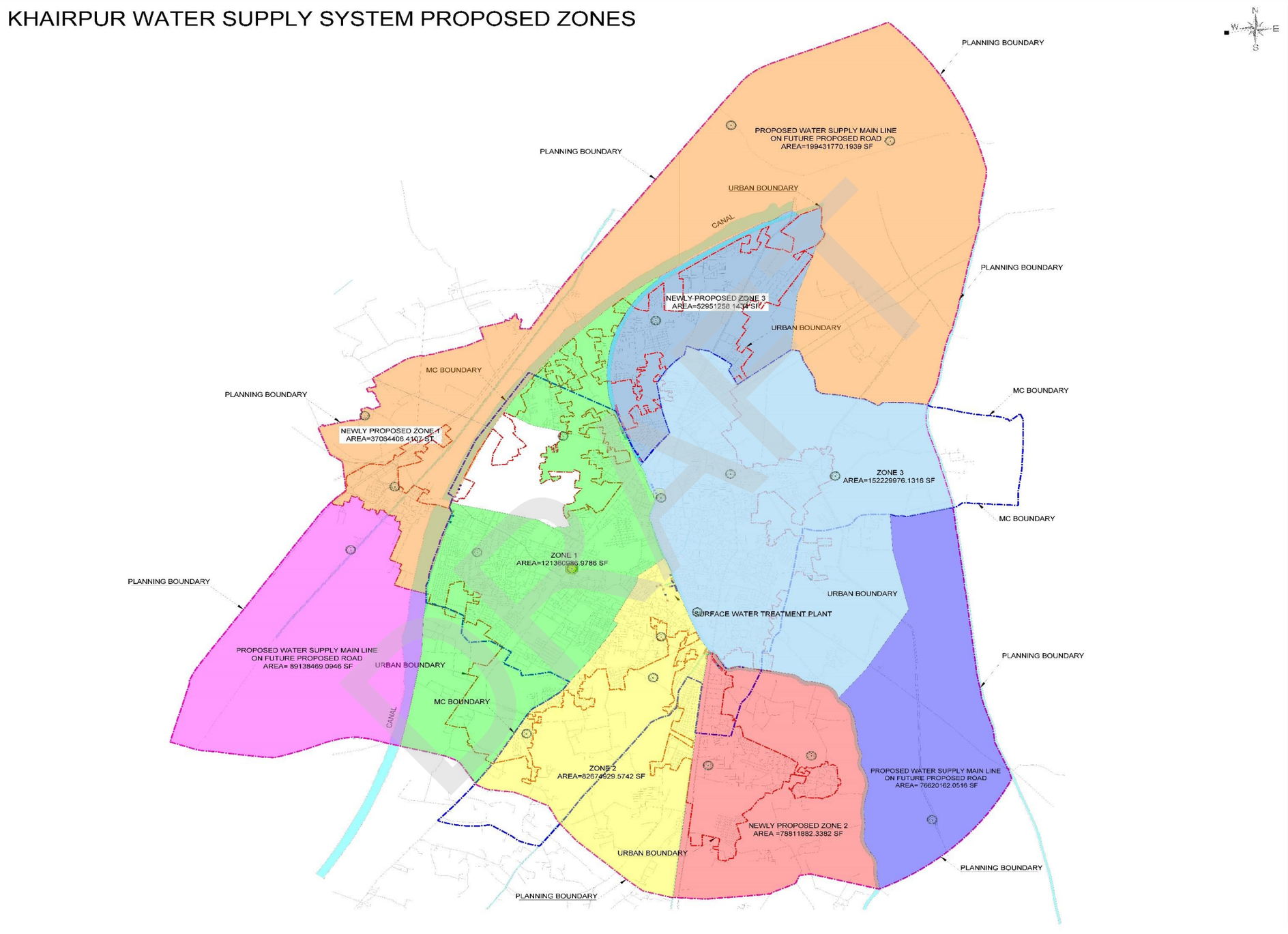


Figure 8-4, Proposed Water Supply Zones – 2043

Source: *The Consultant Team*

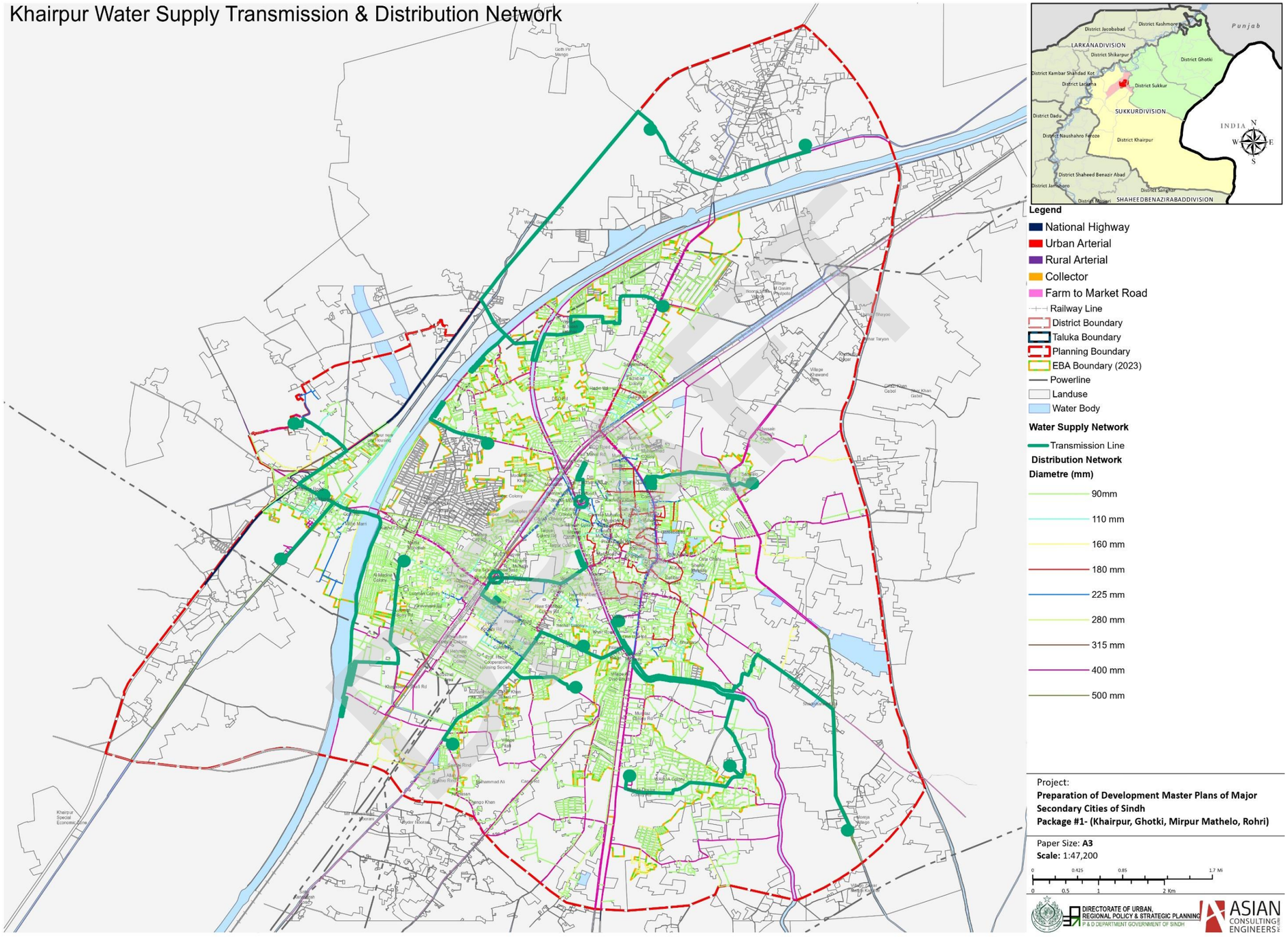


Figure 8-5, Existing and Proposed Transmission Main and Distribution Network for Khairpur City – 2043

Source: *The Consultant Team*

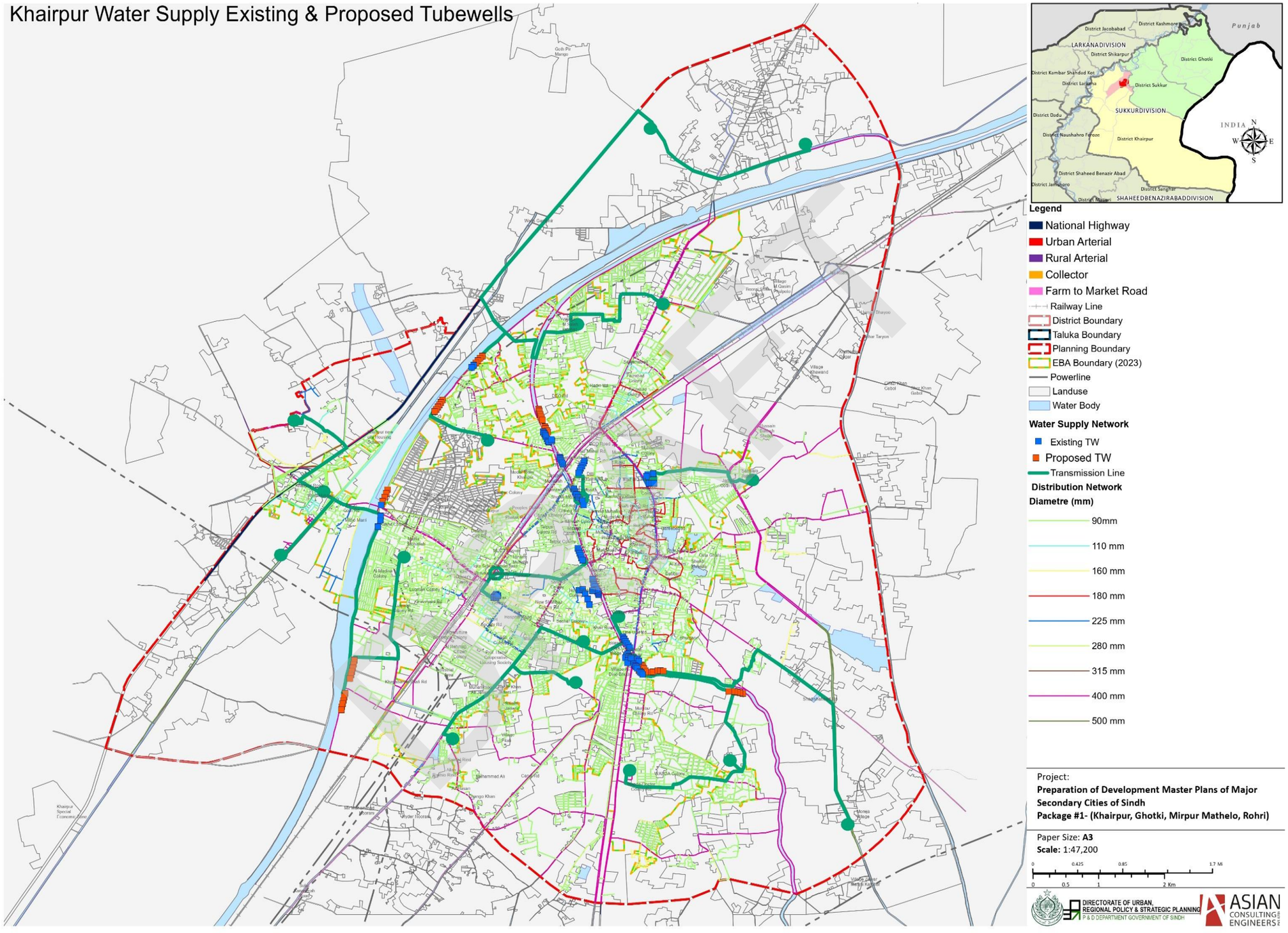


Figure 8-6, Existing and Proposed Tube Wells Location for Khairpur City – 2043

Source: *The Consultant Team*

H. Operation and Maintenance (O&M) Staff for Water Supply

The proposed O&M staffing for year **2043** has been estimated based on the projected population and service requirements for water supply in the following table;

Table 8-17, O&M Staff Detail

Category	Position	No. of Staff	Key Responsibilities
Management & Supervision	O&M Manager / Executive Engineer	1	Overall management of water supply & sewerage system, planning and reporting.
	Assistant Engineer / Deputy Manager	1	Supervision of operations, maintenance planning, staff monitoring.
	Sub-Engineer / Inspector	1	Field inspections, fault reporting, coordination of repair works.
Water Supply System	Pump / Tubewell Operators	30	Operation of tubewells and pumping stations (shift-based coverage).
	OHR Operators / Caretakers	10	Operation and monitoring of overhead reservoirs.
	Plumbers / Line Men	4	Leakage repair, pipeline maintenance, house connections.
	Electricians / Electrical Technicians	4	Maintenance of motors, panels, wiring and generators.
	Mechanical Fitters / Technicians	4	Maintenance of pumps, valves, mechanical equipment.
Support Staff	Drivers (General)	1	Transport for maintenance teams
	Sweepers / Cleaners	1	Cleaning of offices and facilities

8.2.5 Priority Projects

As water supply system of MC Khairpur covers almost 63% of the urban area of MC. Now it is proposed to provide the new water supply network for 37% of Khairpur MC Urban boundary (Approx. 2,100 Acres).

A. Replacement of Existing Water Supply Network for Urban Boundary (Excluding Core Urban Area)

1. Project Justification

Existing Water Supply network in Khairpur city is in poor condition and most of it requires repair & rehabilitation. The existing water supply pipe in the city is

of Asbestos Cement material. AC pipes are outdated and not implemented for water supply. MC Khairpur officials were also of the concern that the Asbestos cement water supply pipes need to be replaced with HDPE pipelines outside the core urban area. This project will help to improve the capacity of supply water schemes already exist in city. Repair and rehabilitation cover main components like; necessary Excavation, Pipe cost, Gate valve/ Washout valve/ Air release valve, Joints repairs, Balancing slopes at all network, Checking of pipe life with rupture checker and Valves for area wise pressure maintenance.

Project Size	
Population of Khairpur Urban Boundary	331,302
MC Area of City in Acres	7,413
Urban Boundary Area within MC in Acres	3,944
Installation of New water supply scheme (**as replacement of outdated AC pipes outside the core urban area)** for 63% (3945 Acres) of Khairpur City @ Rate of 0.165 million Per Acre	651

2. Project Benefits

After implementing of this project, the overall water infrastructure of the Khairpur city will gets enhanced and residents of the Khairpur will be utilizing the water according to the demand.

3. Implementing Authority

Government of Sindh - PHE Department Khairpur MC.

4. Estimated Cost

651million PKR Approx. (Short Term)

B. Provision for New Water Supply Network

1. Project Justification

According to socio economic survey results, about 37% population of Khairpur city has no water supply network and dependent on hand pump and community wells. People purchase their potable water through tankers due to unavailability of water supply network. This project will help to make possible supply of water in those areas where the network is not available and existing network is discontinued. Provision of New Water Supply Network will cover main components i.e. Excavation, Pipe cost, gate valve/ Washout valve/ Air release valve, Joints repairs, Balancing slopes at all network, Checking of pipe life with rupture checker and Valves for area wise pressure maintenance.

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Project Size	
Population of Khairpur Urban Boundary	331,302
MC Area of City in Acres	7,413
Urban Boundary Area within MC in Acres	3,944
Installation of New water supply scheme for 37% (2100 Acres) of Khairpur city @ Rate of 1.2 million Per Acre	2,520

2. Project Benefits

As already discussed above that 37% of Khairpur MC has not a proper supply of clean Water. So, after implementing this project, the Potable water will easily supply to the rest of the residents of the city.

3. Implementing Authority

Government of Sindh - PHE Department Khairpur MC.

4. Estimated Cost

2,520 million PKR Approx. (Short Term)

C. Repair and Rehabilitation of Water Treatment Works

1. Project Justification

At present, two fresh water sources for Khairpur MC are Mir Wah and Rohri canal. To meet the water requirement of the city, two surface water treatment plants are present, out of which one is functional and other is abandoned. including pumping stations, were constructed in different phases:

- Water treatment plant (Khakhee Shah) of capacity 0.5 MGD with 3 pumping stations is functional.
- Water treatment plant (Phase-V) is abandoned.

The entire water demand depends on the surface / canal water. It is recommended to utilize both existing water treatment works for providing filtered water to Khairpur City through their rehabilitation.

2. Project Benefits

This project will help to provide filtered water supply to the city, in order to avoid consumption of contaminated water by the people of Khairpur City.

3. Implementing Authority

Government of Sindh- PHE Department Khairpur.

4. Estimated Cost

109 million PKR Approx. (short Term)

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Table 8-18, Proposed Priority Projects - Khairpur City

S. No.	Project Name	Estimated Cost In Millions	Status	
			Short Term	Long Term
Water Supply				
1	Repair and Rehabilitation of existing Water Supply Network 63% (3945 acres) except core urban area.	651	(Phase Wise)	-
2	Provision of New water supply network for remaining 37% (2100 Acres) except core urban area.	2,520	(Phase Wise)	-
3	Repair and Rehabilitation of Water Treatment Works at Khakhee Shah.	109	(Phase Wise)	-

D. Planning Concept for Urban Boundary (2028)

The total projected population of Core Urban for year is 182,311. The total average demand is 16.07 cusec. The required maximum daily demand is 24.10 cusec. The diameters use in this zone range from 82.5 mm to 367.7 mm. The length of pipe of diameter 82.5 mm, 101 mm, 146.8 mm, 206.8 mm, 257.4 mm, 289.4 mm and 367.7 mm is 1,323,158 ft, 40,253 ft, 49,577 ft, 41,194 ft, 47,984 ft, 5,798 ft 51 ft, and 282,816 ft respectively. An economical velocity must therefore be chosen for each zone is less than 5 ft/sec. The layout for water supply network of Urban Boundary has been shown in **Figure** 8-7**.**

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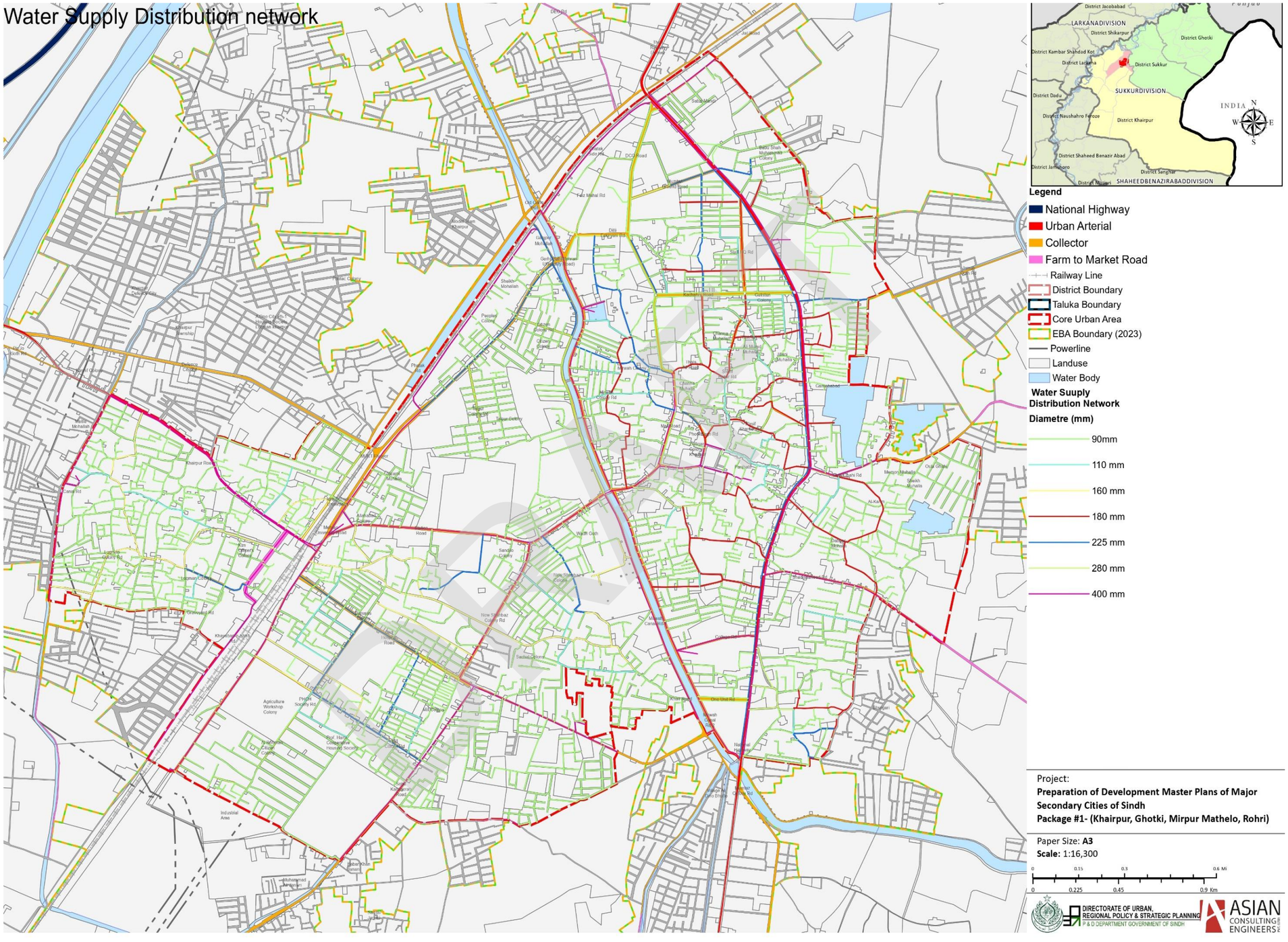


Figure 8-7, Water Supply Priority Project Distribution Network of Khairpur

Source: *The Consultant Team*

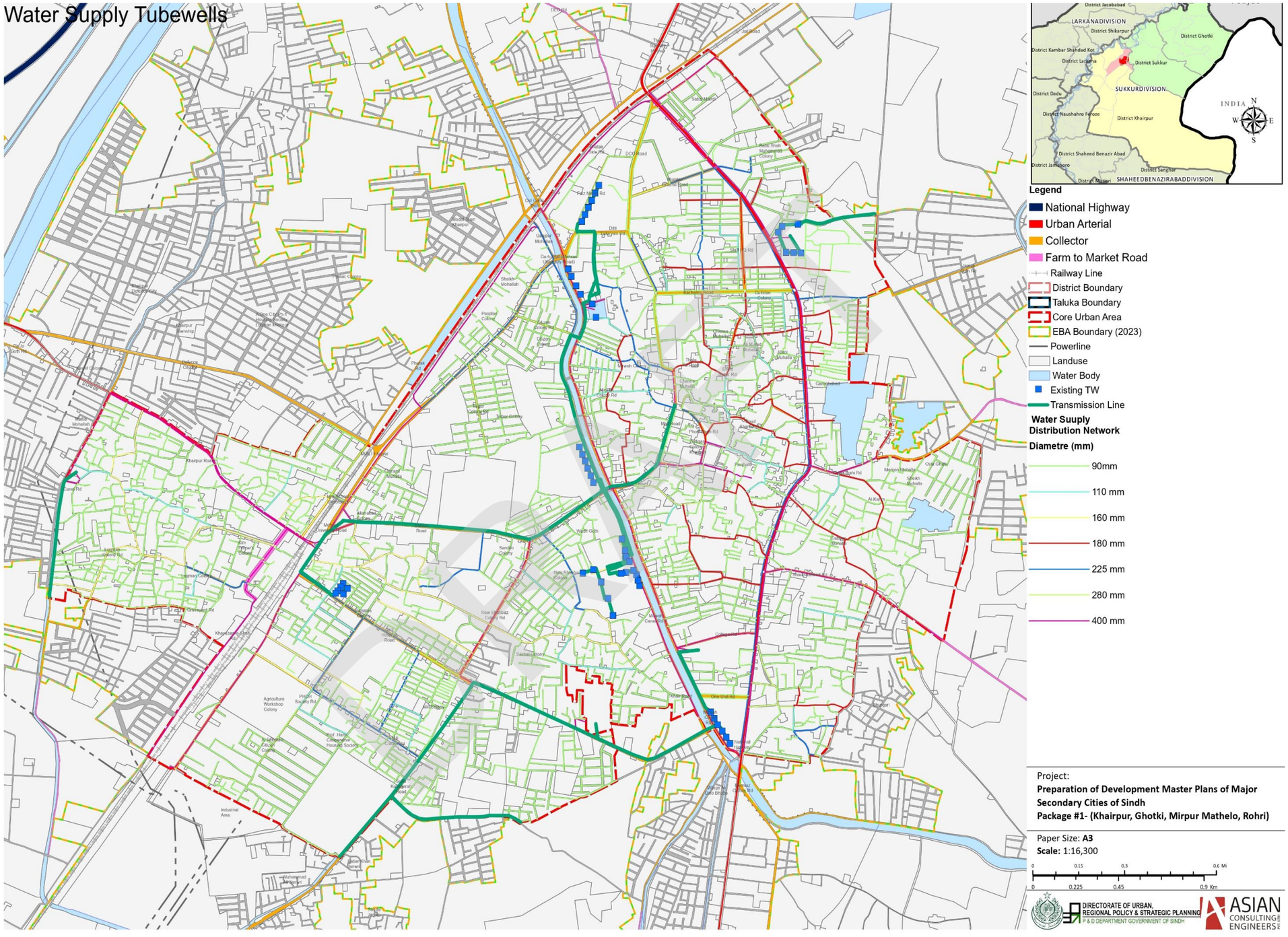


Figure 8-8, Water Supply Priority Project Tube Well Details of Khairpur

Source: *The Consultant Team*

Table 8-19, Population of Urban Boundary (2028)

Urban Boundary	Population
	2028
Total Population	331,302

E. Water Demand

Total water demand for the project area is calculated on the basis of design criteria as discussed in **Immediate Action Plan (IAP)** Report; Section 3, Heading No. **3.4.3 (Design Criteria for Water Supply)**. Based on the design criteria, water demand of the city is estimated in **Table** 8-20

Table 8-20, Total Average Demand of 2028

Parameter	Unit	Value
Urban Boundary		
Projected Population (2028)	Persons	331,302
Average Domestic Water Demand	GPD	11,926,872
Average non-domestic water demand @ 20% of domestic water demand	GPD	2,385,375
Domestic and Non-Domestic Average Water Demand	GPD	14,312,247
Unaccounted Water Demand	GPD	1,431,225
Total Average Water Demand	GPD	15,743,472
	Cusecs	29.2
Max Day Demand @ 1.5 of Avg. Day demand	Cusecs	43.8
Peak Hour Demand @ 1.5 of max day demand	Cusecs	65.7

Source: *The Consultant Team*

F. Tubewells

On the basis of above recommendation, recharge water along the canals will be used for future demand of the city.

As per total demand of water, calculation for the tubewells is shown in **Table** 8-21.

Table 8-21, Calculation of Tubewells

Urban Boundary	Projected Population	Total Average Water Demand	Maximum Day Demand		No. of Tubewells	
	2028	(GPD)	GPD	Cusec	Tubewells required to fulfil the demand	
					0.25 cusec	1 cusec
Total	**331,302**	**15,743,472**	**23,676,728**	**43.80**	**7**	**64**

Based on the above calculation, we have made 23 tubewell of 1.0 cusec and 3 tubewell of 0.5 Cusec Non0functional to Functional and layout of TW,s location is shown in **Figure** 8-6.

Details of tubewells are given in the Table 8-22.

Table 8-22, Detail of Tubewells

Urban Boundary	No. of Tubewells @ 1 Cusec		No. of Tubewells @ 0.25 Cusec	
	Existing Functional TWs	Non-functional TWs made Functional	Existing Functional TWs	Non-functional TWs made Functional
Total	41	23	4	3

G. Overhead Water Reservoir

Overhead Reservoirs (OHRs) are also key component of water distribution system. In water supply system OHRs serve the following functions:

- Store water for use during electric load-shedding and during maintenance works of tube-wells/ pumps.
- Provide balancing of flow and pressure during peak hours.

Storage Capacity of Overhead reservoirs should be based on around 1/10th of average day demand.

Based on average water demand of the project area, required storage is calculated in **Table** 8-23.

Table 8-23, Calculation of OHRs

Urban Boundary	Projected Population	Total Average Water Demand	OHRs		
	2028	(GPD)	Existing	Proposed	Total
Total	331,302	15,743,472	2	11	13

Based on above calculation, we required total 13 OHRs. 2 OHRs of capacity 100,000 Gallons each are present. Additional new 8 OHRs of 100,000 Gallons, and 3 OHRs of 200,000 Gallons capacity are proposed.

8.2.6 Immediate Action Plan for Core Urban Area

Khairpur is situated in the Northern part of Sindh. The district is bounded on the North by Shikarpur and Sukkur districts, on the East by India, on the South by Sanghar and Nawabshah districts and on the West by Nawabshah and Larkana districts. The area of the district is 15,910 sq.km and the Core Urban boundary is estimated as 9.16 sq.km. The main source of water supply to Khairpur is the Mir Wah and Rohri canal.

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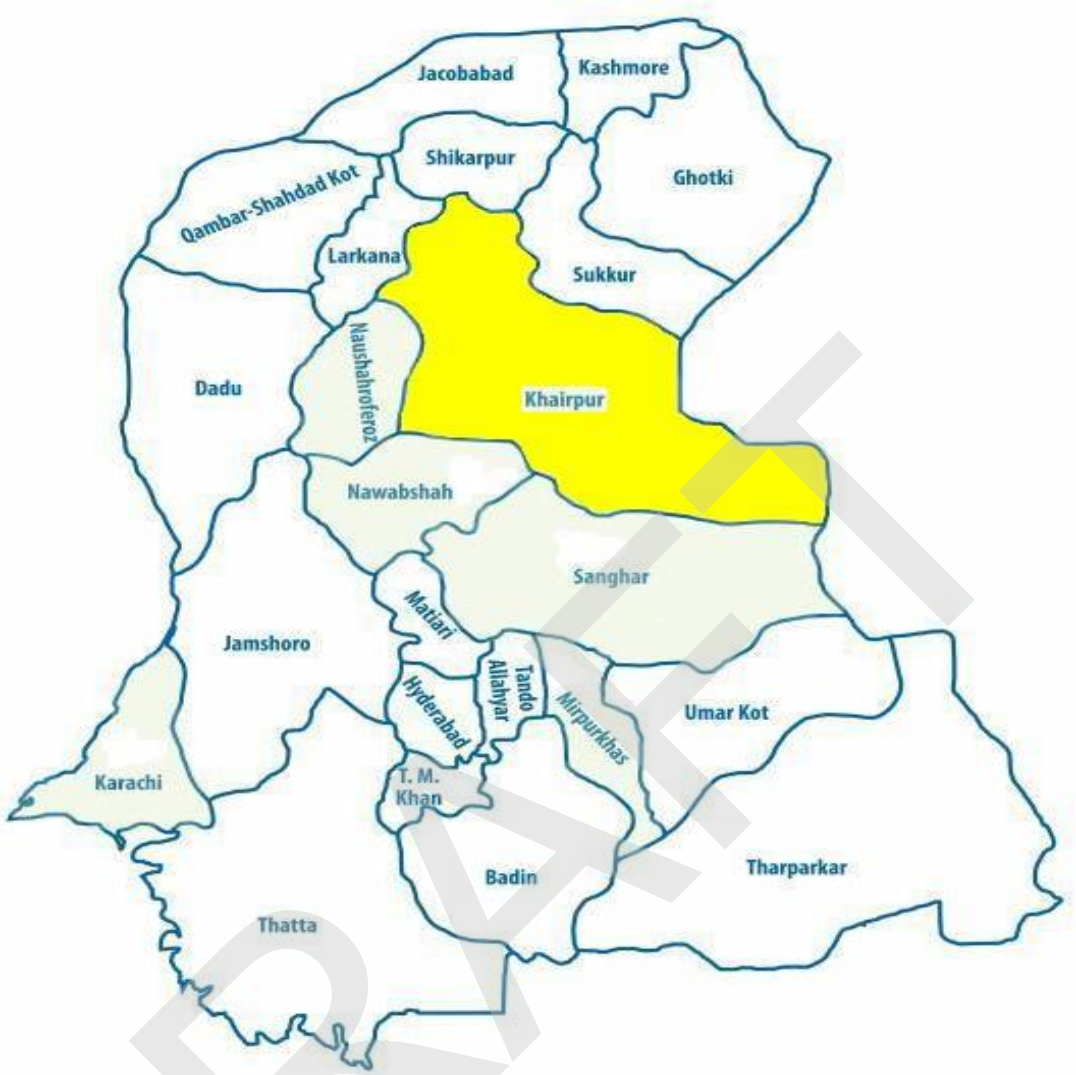


Figure 8-9, Location Map of Khairpur

A. Distribution Network (Water Surface Treatment Plant)

Water supply at present works out to 0.5 MGD. Water is stored in an underground reservoir and distributed through 2 OHRs of 100,000 Gallons each. The distribution network includes AC/PVC pipes of sizes from 3" to 16" diameter. There is no zoning system of distribution and no water meters are installed. Distribution network improvement (DNI) is essentially required for equitable distribution. The Layout of existing water supply network is shown in **Figure** 8-10.

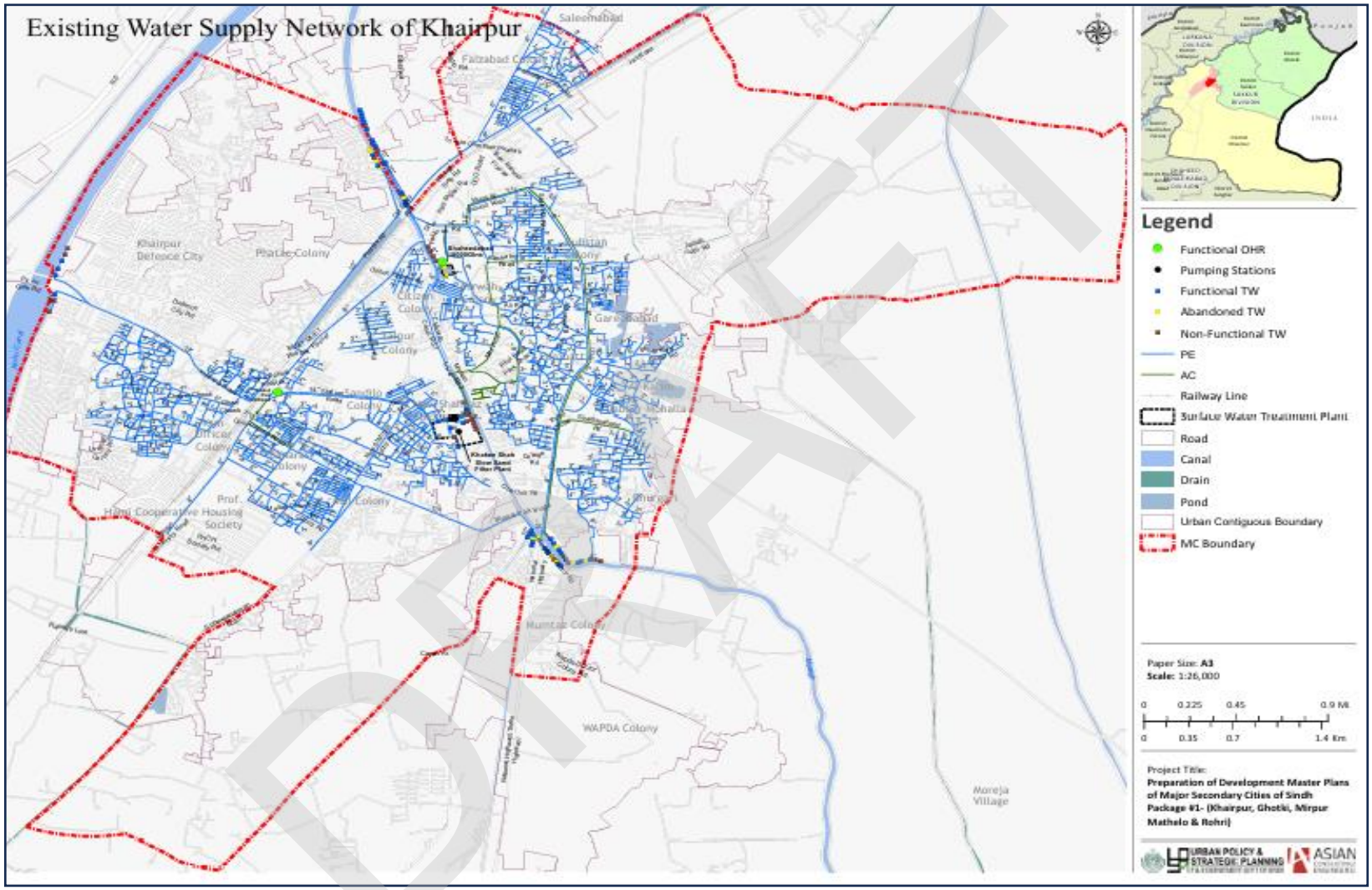


Figure 8-10, Existing Water Supply Network of Khairpur

Source: *The Consultant Team*

B. Water Supply Network Core Urban Area

Existing water supply scheme of core area has passed ages and became outdated, core area of Khairpur is counted as densely populated area of city, residents of core area are complaining regarding the quality of water supplied to residents. Mixing of drainage with fresh Water is major issue observed during survey. So therefore, it is proposed to repair and rehabilitate existing water supply network of core urban area as Immediate Action Plan

Table 8-24, Rehabilitation of Existing Water Supply Network of Core Urban Area Khairpur (2264 Acre)

Sr. No.	Name	Area (acre)	Per acre cost (PKR) million	Cost (PKR)
1.	**Rehabilitation of Water Supply System for Core Urban Boundary**	2,264	0.316 million Per acre	715.5
Total Cost (PKR). Million				**715.5**

Note: *Water supply system rehabilitation includes supply pipe networks, pumping machinery and equipment's for more efficient and effective supply of water.*

Table 8-25, Break Up Plan for Rehabilitation of Water Supply Pipes

S. No.	Priority Project List for Water Supply in Core Urban Area	Length (Rft)
1	Replace AC pipe of 459.7 mm with HDPE pipe 500	4127
2	Replace AC pipe of 367.7 mm with HDPE pipe 400	1977
3	Replace AC pipe of 289.4 mm with HDPE pipe 315	7493
4	Replace AC pipe of 257.4 mm with HDPE pipe 280	3283
5	Replace AC pipe of 206.8 mm with HDPE pipe 225	3968
6	Provision of Machinery at 18 No of Non-Functional Tube Wells along Mirwah Canal (Each Pump of 1 cusecs)	18
7	10 Nos. New Tube Wells to be Installed along Mirwah Canal (1 cusecs each)	10
8	HDPE Rising Main of 5 KM of Diameter 500 mm (OD)	16,405

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C. Planning Concept of Core Urban Area

The total projected population of Core Urban for year is 182,311. The total average demand is 16.07 cusec. The required maximum daily demand is 24.10 cusec. The diameters use in this zone range from 82.5 mm to 367.7 mm. The length of pipe of diameter 82.5 mm, 101 mm, 146.8 mm, 206.8 mm, 257.4 mm, and 367.7 mm is 503,106 ft, 24,355 ft, 67,914 ft, 31,903 ft, 10,127 ft, and 84,325 ft respectively. An economical velocity must therefore be chosen for each zone is less than 5 ft/sec. The layout for water supply network of core urban area has been shown in **Figure** 8-11.

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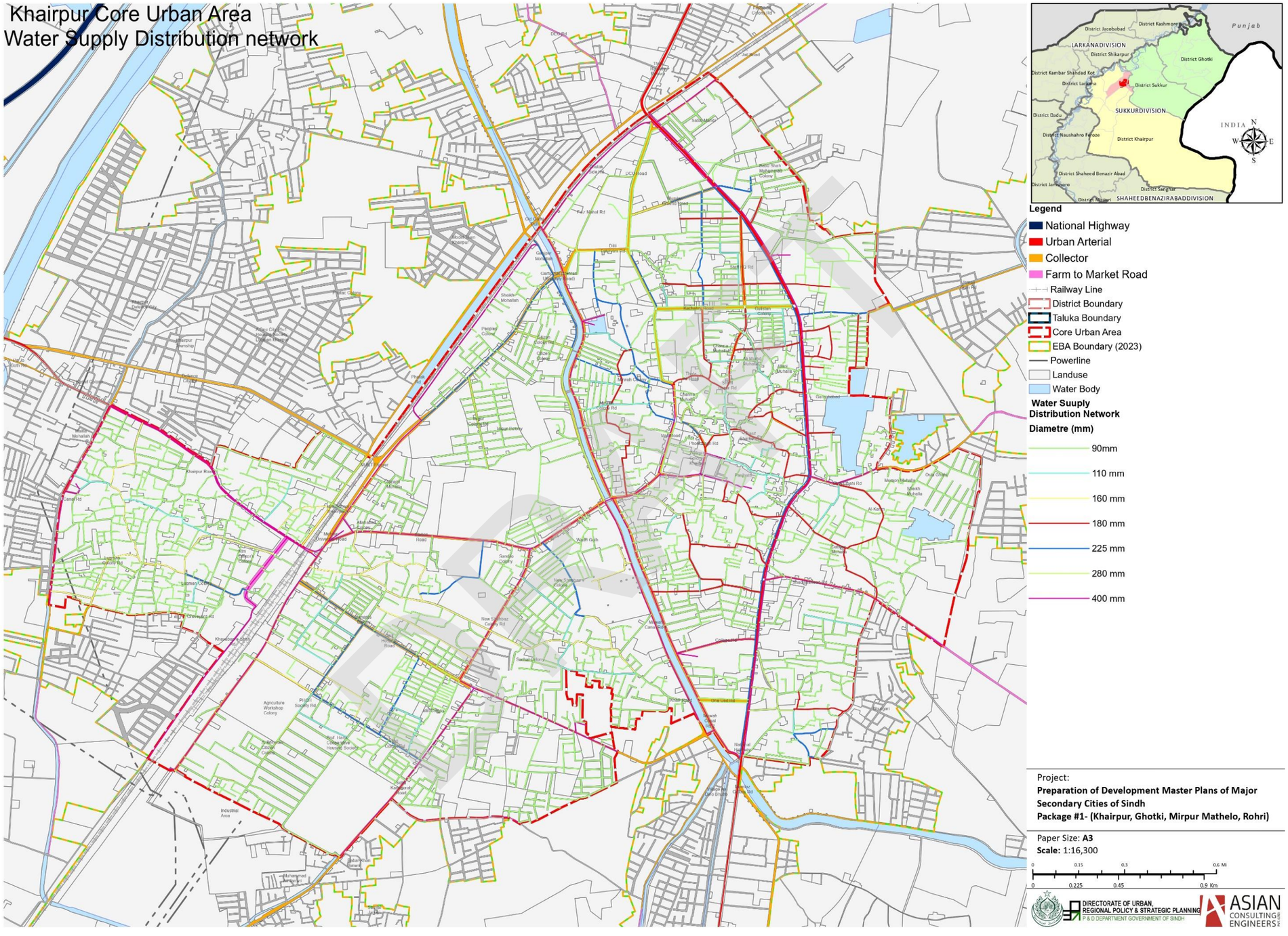


Figure 8-11, Immediate Action Plan Map Distribution Network of Khairpur for Water Supply

Source: *The Consultant Team*

Table 8-26, Population of Core Urban Boundary

Core Urban	Population
	2025
Total Population	182,311

D. Water Demand

Total water demand for the project area is calculated on the basis of design criteria. Based on the criteria, water demand of the city is estimated in **Table** 8-27.

Table 8-27, Total Average Demand of 2025

Parameter	Unit	Value
Core Urban Boundary		
Projected Population (2025)	Persons	182,311
Average Domestic Water Demand	GPD	6,563,196
Average non-domestic water demand @ 20% of domestic water demand	GPD	1,312,639
Domestic and Non-Domestic Average Water Demand	GPD	7,875,835
Unaccounted Water Demand	GPD	787,584
Total Average Water Demand	GPD	8,663,419
	Cusecs	16.07
Max Day Demand @ 1.5 of Avg. Day demand	Cusecs	24.105
Peak Hour Demand @ 1.5 of max day demand	Cusecs	36.16

Source: *The Consultant Team*

E. Tubewells

On the basis of above recommendation, recharge water along the canals will be used for future demand of the city.

As per total demand of water, calculation for the tubewells is shown in **Table** 8-28.

Table 8-28, Calculation of Tubewells

Core Urban	Projected Population	Total Average Water Demand	Maximum Day Demand			No. of Tubewells
	2025	(GPD)	GPD	Cusec		Tubewells required to fulfil the demand
					0.25 cusec	1 cusec
Total	**182,311**	**8,663,419**	**13,027,027**	**24.10**	**4**	**36**

Based on the above calculation, we need 4 tubewells of 0.25 cusec and 36 tubewell of 1.0 cusec. Details of tubewells are given in the **Table** 8-29.

Table 8-29, Detail of Existing functional Tubewells

Core Urban	No. of Tubewells @ 1 Cusec	No. of Tubewells @ 0.25 Cusec	Total
	Existing Functional Tubewells		
	41	4	45

F. Overhead Water Reservoir

Overhead Reservoirs (OHRs) are also key component of water distribution system. In water supply system OHRs serve the following functions:

- Store water for use during electric load-shedding and during maintenance works of tube-wells/ pumps.
- Provide balancing of flow and pressure during peak hours.

Storage Capacity of Overhead reservoirs should be based on around **1/10th** of average day demand.

Based on average water demand of the project area, required storage is calculated in **Table** 8-30

Table 8-30, Calculation of OHRs

Zones	Projected Population	Total Average Water Demand	OHRs		
	2023	(GPD)	Existing	Proposed	Total
Core Urban Boundary	182,311	8,663,419	2	4	6

Based on above calculation, we required total 6 OHRs. 2 OHRs of capacity 100,000 Gallons each are present. Additional new 5 OHRs of 100,000 Gallons, and 1 OHRs of 200,000 Gallons capacity are proposed.

8.3 Sewerage and Drainage

8.3.1 Existing Situation

Sewage is collected and catered by both open/covered drains and piped network. Piped sewerage network has been laid in few streets but mostly sewage is being collected through drains. The flow from these sewers is collected in main sewerage line which ultimately dispose of the collected sewage in a disposal station. The ultimate disposal of sewage is the drain, open/agricultural land and Mirwah/Rohri canal without any treatment.

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Problems in Existing Sewerage System

Analysis of the existing municipal services infrastructure and the quality-of-service delivery was done. Site visits to actual problematic areas in the Khairpur city are conducted to identify the problems, bottlenecks and shortcomings in the infrastructure itself and its operation and maintenance for each municipal service along with the correction/updating of descriptive maps.

There is an inadequate, under capacity and outlived network of sewers as well as Surface Drains and lack of facilities for disposal so under capacity existing sewer needs to be replaced and rehabilitation of disposal stations are needed. Ghareebabad, Somro Colony and Kaholra Phatac disposal stations, need rehabilitation and ongoing maintenance to ensure they can operate to design capacity with appropriate screening.

Diameter (Inches)	Length (ft)
9	7157
12	7414

A. MC Officials/Stakeholder Consultation

The city was visited to,

1. Verify and correct the data provided by the Municipal Committee/Public Health Engineering Department (PHED).
2. Update the descriptive maps of all the services by consultation with MC staff and Public Health Engineering staff.
3. The condition of existing disposal stations (design capacity, number and capacity of wet wells, pumps and capacity, generators) and existing treatment facilities.
4. Identify the required improvements and extension of the municipal services infrastructure.

1. Meeting/Discussion with MC's Official

The Consultant Team, visited Khairpur city for the purpose of detailed Reconnaissance/Technical survey. Firstly, The Consultant Team met MC administration where detailed discussion was carried out regarding provided maps of sewerage system.

2. Detail Reconnaissance Survey

To study the sewerage and drainage facilities in project area, a team comprising Water and Sanitation Engineers along with MC representatives visited the existing disposal station sites and developed the inventory of existing disposal stations. The visit was carried out from 13-02-2025 to 21-02-2025. The study of existing 06 disposal stations was made. The detailed inventory of existing disposal stations is given in Table 10 8.

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Furthermore, point of ultimate disposal of different disposal stations were visited. Also made sure the main sewer lines diameters, materials and their routes after confirmation from MC Officials. The Consultant Team, also visited the flooded and unserved areas where surveys from different people were conducted to gather information about sewerage/drainage issues.

Some pictorial view of reconnaissance Survey is shown as below;



- Existing features of Sewerage System in Khairpur City
- Existing sewerage system in Khairpur is a combination of the following assets;
    1. Sewer lines
    2. Open/Covered Drains
    3. Disposal Stations
    4. Force Main

B. Sewer Lines

In Khairpur sewerage system has been laid in the few areas, however the same is facing multiple problems throughout the city that ranges from under capacity sewers to over aging and choking of sewer. This can result in crown failure and ponding in different parts of the city. The sewerage system in the city is mostly planned and constructed by Public Health Engineering Department (PHED) and subsequently handed over to MC for operation and maintenance.

At present, MC is operating and maintaining sewer lines of 9'' to 36'' laid in various phases and sub projects connected with disposal stations. Total length of sewer network in Khairpur City is approximately 11 Km.

C. Open/Covered Drains

Most of the area is covered by open/covered drains. Total length of drains in Khairpur City is approximately 108 Km. Open and covered drains are there to cater the domestic sewage flow as well as stormwater flow of that area. These small drains dispose of their sewage to main drains of larger size ranging from 1.0' x 2.0', 1.5' x 3.0', 3.0' x 7.0' and 4.0' x 7.0'. These drains ultimately disposing their flow to disposal stations. All these drains are clogged with a lot of solid waste and sediments thus has significantly reduced their carrying capacity.

Presently, there exist Twenty-Six (26) disposal/lift stations in Khairpur city. These are used for pumping of the sewage/storm water to the final disposal points. 21 Nos. disposal stations are functional, while 04 Nos. disposal stations are non-functional and disposing of the raw sewage into nearby water bodies like Rohri canal and Mirwah canal etc. A graphical representation of functional and non-functional disposal stations is given below.

D. Number of Operational and Non-Operational Disposal Stations

The existing disposal stations generally consists of screening chamber, wet wells, dry wells and force main. These are made of brick walls. The pumps are horizontal centrifugal. Screening chambers and wet wells in few disposal stations have been choked.

Wastewater from disposal stations is being carried through force main. Brief summary of disposal stations is as follows:

Table 8-31, Brief Summary of Disposal Stations

Sr. No.	Name of Disposal Station	Year of Construction	Designed Capacity (Cusec)	Status	Discharge Point
1	Jamali Goth	2012	12	Functional	Jamali Goth Nallah
2	Ghai	1997	4	Functional	Jamali Goth Nallah
3	Murad Shah	2014	1.5	Functional	National Highway Nallah
4	Lashari Mohallah	1988	6	Functional	Mirwah Canal
5	Rajpur Mohallah	1988	3	Functional	Mirwah Canal
6	Dabbar Mohallah	2022	4.5	Functional	Mirwah Canal

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Sr. No.	Name of Disposal Station	Year of Construction	Designed Capacity (Cusec)	Status	Discharge Point
7	Altaf Colony	1987	2	Functional	Mirwah Canal
8	Khakhee Shah	1984	6	Functional	Mirwah Canal
9	Naveed Colony	2019	1	Functional	Mirwah Canal
10	Superior College	2004	1.5	Functional	Mirwah Canal
11	Wandh	1997	3	Functional	Mirwah Canal
12	Shahbaz Colony	1992	1.5	Functional	Janwari Goth Nallah
13	Banaras Colony	1997	3	Functional	Janwari Goth Nallah
14	Khokhar Goth	1998	2	Functional	Jamali Goth Nallah
15	Bhutta Gopang	2013	0.5	Non-Functional	Mirwah Canal
16	Maitla	1988	5	Functional	Rohri Canal
17	Jan M. Janwari Goth	2014	3	Functional	Rohri Canal
18	Eidgah Luqman Colony	1997	1.5	Functional	Rohri Canal
19	Janwari Goth	1997	1	Non-Functional	Agricultural Land
20	Allahbad Colony	2020	1	Non-Functional	Janwari Goth Nallah
21	Unar Colony	1996	4.5	Functional	Mirwah Canal
22	People Colony	2017	2	Functional	Mirwah Canal
23	Souf Khan Janwari	2013	3	Functional	Janwari Goth Nallah
24	Azam Colony	2001	2	Functional	Rohri Canal
25	Faizabad Colony	2013		Non-Functional	-
26	Allahbad Colony New	Under Construction			

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Table 8-32, Summary of Sewerage System

Sr. No.	Component	Quantity
1	Sewer lines	11 km
2	Open drains	108 km
3	Disposal Stations	26 nos.
4	Oxidation Pond (WWTP)	Under Construction

***Source**: Data obtained from digitized map and field surveys*

E. Force Mains

Diameter (inch)	Length (ft)	Material
8	3,725	PVC
10	2,679	PVC
12	5,701	AC, PVC

F. Unserved Areas

The following areas were found un served areas.

- Phatac Colony
- Khairpur defence city
- Mumtaz colony

8.3.2 Detailed Sewerage and Drainage System

A. Existing and Projected Population for Sewage Calculation

The existing Population of Planning Boundary of Khairpur for the year 2023 is 441,495. As per Urban planning a growth rate of 2.93 is adopted. The population for the years 2028, 2033, 2038 and 2043 is (493,539), (553,047), (621,155) and (699,173) respectively.

The population for the year 2043 (699,173) is considered for the strategic planning of the Khairpur City for the year 2043.

8.3.3 SWOT Analysis

	Internal Factors	External Factors
Positive Impacts	**STRENGTHS** **Sewerage and Drainage System:** • The existing Sewerage/Drainage System facilitates the city. • Experienced staff available with the organization related to sewerage and drainage system.	**OPPORTUNITIES** **Sewerage and Drainage System:** • Replacement and Rehabilitation of existing disposal stations and their machinery. • Improvement of general hygiene/ public health by cleaning sewerage/drainage system. • Revenue can be generated by charging services for cleaning. • Job opportunities for skilled staff for

	Internal Factors	External Factors
		proper maintenance. • Treatment of wastewater for safe disposal of wastewater to water bodies. • Development of legislation, regulation and updating of existing rules / standards.
Negative Impacts	**WEAKNESSES** **Sewerage and Drainage System:** • No systematic updating of GIS mapping and asset inventory. • No sewerage tariffs are being collected. • Capacity development and training mechanism is not in place. • No SOPs and OandM manuals. • Due to poor maintenance condition; garbage (solid waste) enters into sewers/drains. • 67% Urban area is not connected to sewerage/drainage system. • There is no sewerage treatment plant, water bodies getting polluting due to raw sewage discharges.	**THREATS** **Water Supply, Sewerage and Drainage System:** • Resistance to pay for water and sewerage services. • System inefficiency and reduced delivery of services. • Negative health impact on community due to improper sewerage and waste disposal. • Spreading of epidemic / pandemic, pollution of water bodies due to untreated sewerage. • Stormwater flooding or overflow of sewers/drains due to extreme weather events, such as excessive rainfalls.

8.3.4 Feasibility Analysis

The proposed projects of sewer are designed to meet the immediate water demand outlined in the action plans. A detailed analysis has been conducted for the placement and number of tube wells, as well as the required pipeline lengths, to ensure efficiency and effectiveness. The pipe materials and tube well capacities have been selected carefully, keeping in mind both technical requirements and cost considerations. This ensures that the system performs reliably without exceeding budgetary constraints. The overall design maintains a balance between performance and economic viability. In the case of the sewerage system, the pollution load to be managed by the trunk sewers has been thoroughly studied. Routes for the trunk sewers have been selected to avoid excessive excavation depths, which helps reduce construction challenges and costs. The alignment of sewer lines ensures minimal disruption to existing infrastructure and natural terrain. These design decisions contribute to the overall feasibility and sustainability of the project. The proposed systems are practical, efficient, and ready for timely implementation.

8.3.5 Strategic Development Plan

This section describes the detailed design of different components of sewerage and drainage system till year 2043.

A. Population Projection

Population density method is used to calculate total number of persons in one zone.

Percentage of area occupied by one zone is calculated then multiplied by total population to get number of persons in that specific zone.

The methodology for Population projection is added in the report. Further population projection is corresponding to the land use and master planning concept. Similar values and population density is adopted for calculation of population up to the draft strategic planning horizon, priority planning and immediate action plan for calculating the loads and demands of the utilities proposed on the master planning.

B. Zoning Criteria

The zoning criteria adopted for sewerage system is in accordance with the landuse plan provided for all the four cities. The extent of zoning is based on the following factors:

- Topographic levels and terrain following the disposal pattern into the water bodies after treatment.
- Landuse available for proposing the Wastewater treatment plants.
- Pollution load contributing to the existing and proposed disposal stations is aligned with the zoning criteria.

The detailed zoning maps corresponding to the exact master planning for the city is provided below.

C. Planning Concept for Trunk Sewer – Khairpur City (2043)

According to the Detailed Design of sewerage and drainage system of Khairpur City, whole city has been divided into 3 zones to make the sewerage and drainage system easy. Each zone has its own serving area and has its own wastewater treatment plant. The total projected population of year 2043 is 699,173 of Khairpur City and total average demand is 61.63 cusec. The daily flow is 162.38 cusec according to 85% of water supply.

The layout of zone wise trunk sewer has been shown Figure 8-12.

Detail of these zones is given below;

1. Zone-1

The total projected population of Zone 1 is 223,735 and total average demand is 19.7 cusec. The daily flow of zone is 51.83 cusec according to 85% of water supply. The diameters use in this zone range from 9 inches to 48

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inches. The length of conduit of diameter 9 in, 12 in, 15 in, 18 in, 21 in, 24 in, 27 in, 36 in, and 48 in is 39,096.4 ft, 11,309.2 ft, 3,954.2 ft, 15,722.1 ft, 13,133.9 ft, 2,763.5 ft, 3,829.2 ft, 12,951.7 ft, and 5,138.2 ft respectively.

Pipe Diameters	Lengths (ft)
9.0 in	39,096.4
12.0 in	11,309.2
15.0 in	3,954.2
18.0 in	15,722.1
21.0 in	13,133.9
24.0 in	2,763.5
27.0 in	3,829.2
36.0 in	12,951.7
48.0 in	5,138.2
Total Length	**107,898.3**

2. Zone-2

The total projected population of Zone 2 is 382,611 and total average demand is 28.9 cusec. The daily flow of zone is 76.12 cusec according to 85% of water supply. The diameters use in this zone range from 9 inches to 36 inches. The length of conduit of diameter 9 in, 12 in, 15 in, 18 in, 21 in, 24 in, and 36 in, is 43,617.9 ft, 32,452.6 ft, 20,840 ft, 10,120.7 ft, 15,553.2 ft, 14,966.9 ft, and 17,637.8ft, respectively.

Pipe Diameters	Lengths (ft)
9.0 in	43,617.9
12.0 in	32,452.6
15.0 in	20,840.0
18.0 in	10,120.7
21.0 in	15,553.2
24.0 in	14,966.9
36.0 in	17,637.8
Total Length	**155,189.1**

3. Zone-3

The total projected population of Future Zone is 146,826 and total average demand is 12.9 cusec. The daily flow of zone is 34.04 cusec according to 85% of water supply. The diameters use in this zone range from 9 inches to 30 inches. The length of conduit of diameter 9 in, 12 in, 15 in, 18 in, 21 in, 24 in, and 30 in is 10,038.7 ft, 1078.6 ft, 7,409.1 ft, 7,801.4 ft, 5,149.6 ft, 7,624.7 ft, and 13,843.7 ft respectively.

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Pipe Diameters	Lengths (ft)
9.0 in	10,038.7
12.0 in	1,078.6
15.0 in	7,409.1
18.0 in	7,801.4
21.0 in	5,149.6
24.0 in	7,624.7
30.0 in	13,843.8
Total Length	**52,945.9**

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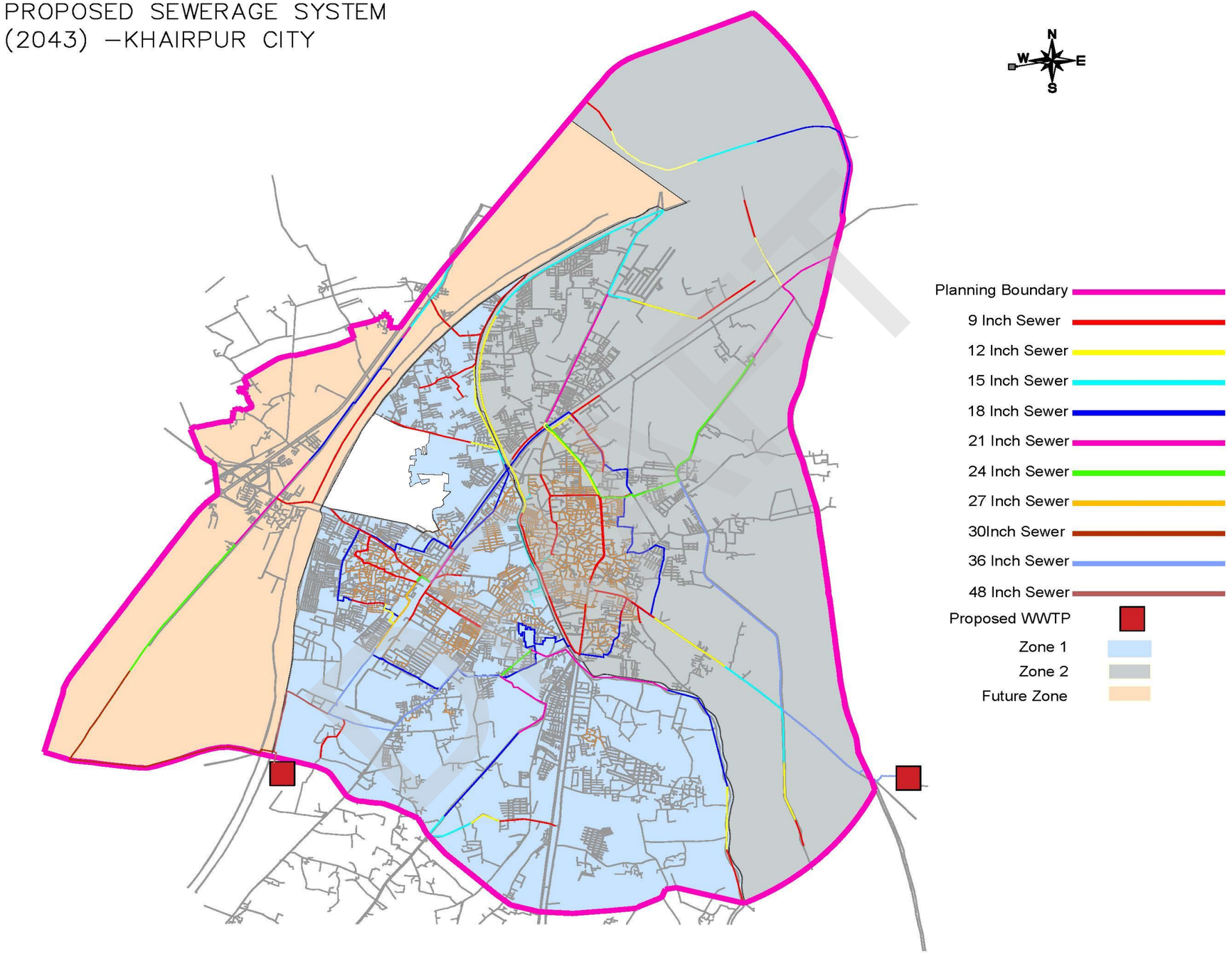


Figure 8-12, Proposed Sewerage Network (2043) in Khairpur

Source: *The Consultant Team*

D. Wastewater Treatment Plant

The treatment and ultimate disposal of municipal wastewater/sewage of Khairpur city is a major concern. Currently, no treatment plant is available for treatment of sewage in the project area of Khairpur city, however one treatment plant is under construction (currently the work is stopped). The raw sewage is being directly disposed into the nearby water bodies (Mirwah and Rohri Canal) or used for agricultural purposes.

It is recommended to construct at least two wastewater treatment plants in zone 1 and zone 2 of capacity of 7.8 and 11.5 MGD with waste stabilization pond for Khairpur City. Waste stabilization pond (WSP) is natural technology which can be installed in centralized or semi-centralized sewerage systems for treatment of domestic and industrial wastewater and sludge, etc. WSPs are highly efficient, simple to construct, low cost and easy to operate but require large area in acres.

Note: *All industries shall install and operate their own wastewater treatment plants (WWTPs), and only treated effluent complying with applicable discharge standards shall be allowed to connect to the city trunk sewer system.*

1. Design Capacity

- Plant 1: 7.8 million Gallons per Day (MGD)
- Plant 2: 11.5 million Gallons per Day (MGD)

Components of Treatment Technology

- **Anaerobic Ponds**
  - **Function:** Initial treatment to settle solids and reduce organic load.
  - **Depth:** 3–5 meters
  - **Retention Time:** 1–5 days
- **Facultative Ponds**
  - **Function:** Biological treatment using aerobic and anaerobic bacteria and algae.
  - **Depth:** 1–2.5 meters
  - **Retention Time:** 5–30 days
- **Maturation Ponds**
  - **Function:** Final polishing to remove pathogens.
  - **Depth:** 0.5–1.5 meters
  - **Retention Time:** 5–10 days

2. Treatment Efficiency

- BOD Removal: 80–95%
- Pathogen Removal: 90–99%
- TSS Removal: 80–90%

Treated effluent is suitable for restricted irrigation or safe discharge to surface waters.

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3. Area Estimation for Treatment Plant

Area needs depend on flow rate, design parameters, and retention times. The following are typical estimates based on standard WSP design:

7.8 MGD WSP:

- Flow Rate: ~35,448 m³/day
- Total Area Required: 53.2 acres
- (Assuming 1.5 hectares per 1,000 m³/day for full WSP train)

11.5 MGD WSP:

- Flow Rate: ~52,263 m³/day
- Total Area Required: 78 acres

Effluent of all treatment plants should be compiling with NEQS standards before discharge.

Critical Parameter	Standard As per NEQS (mg/L unless noted)
pH	6-10
Biochemical Oxygen Demand (BOD5) at 20∘C	80
Chemical Oxygen Demand (COD)	150
Total Suspended Solids (TSS)	150
Total Dissolved Solids (TDS)	3500
Oil and grease	10
Phenolic compounds (as phenol)	0.1
Cyanide (as CN) total	2
Total Toxic Metals	2

E. Suitability of Treatment Technology Adopted for Khairpur City

For Khairpur City, it is recommended to:

- Identify land plots on the outskirts for both 7.8 MGD and 11.5 MGD plants.
- Use a phased construction plan, prioritizing one plant and expanding as demand grows.
- Explore integration with constructed wetlands for final polishing and reuse.

F. Operation and Maintenance (O&M) Staff for Sewerage/ Drainage

The proposed O&M staffing for year **2043** has been estimated based on the projected population and service requirements for sewerage system in the following table;

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Table 8-33, O&M Staff Detail

Category	Position	No. of Staff	Key Responsibilities
Management & Supervision	O&M Manager / Executive Engineer	1	Overall management of water supply & sewerage system, planning and reporting.
	Assistant Engineer / Deputy Manager	1	Supervision of operations, maintenance planning, staff monitoring.
	Sub-Engineer / Inspector	1	Field inspections, fault reporting, coordination of repair works.
Sewerage & Drainage System	WWTP Operators	2	Operation & maintenance of 2 wastewater treatment plants (shift-based).
	Disposal / Lift Station Operators	13	Operation of disposal/lift stations (shift-based coverage).
	Sewerage Electricians / Fitters	2	Electrical + mechanical maintenance of sewer pumps.
	Watchmen / Security	5	Security of disposal/lift stations
Support Staff	Drivers (General)	1	Transport for maintenance teams
	Sweepers / Cleaners	1	Cleaning of offices and facilities

8.3.6 Priority Projects

A. Provision of New Sewerage and Drainage Network for 67% of Khairpur Urban Boundary (Approx: 2,632 Acres)

1. Project Scope and Justification

According to socio economic survey results, about 67% population of Khairpur city is unserved due to unavailability of sewerage and drainage network.

2. Project Size

Therefore, it is proposed to install new sewerage and drainage scheme for unserved 67% area of Khairpur City on priority basis, covering an area of 2632 acres. The remaining 33% area of the Khairpur City Urban Boundary needs to be provided a proper drainage and sewerage network in the city. This project will help the inhabitants of the city for easy disposal of storm water drainage and sewage water in to main drainage system.

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Project Size	
Population of Khairpur Urban Boundary	331,302
MC Area of City in Acres	7,413
Urban Boundary Area within MC in Acres	3,944
Total Coverage of Sewerage and Drainage in Acres	2,632
Installation of New Sewerage network for 67% (2632 Acres) of Khairpur city Urban Boundary @ Rate of 1.5 million Per Acre	3,948

3. Project Benefits

As already discussed above that 67% of Khairpur Urban Boundary is the area of the city which is missing the facility of the sewerage and drainage network will be served.

4. Implementing Authority

Government of Sindh - PHE Department Khairpur MC.

5. Estimated Cost

3,948 million PKR Approx.

B. Repair and Rehabilitation of Existing Sewerage and drainage Network for 33% Khairpur Urban Boundary (Approx. 1312 Acres)

1. Project Scope and Justification

In Khairpur City Sewage is mainly disposed of in covered or open drains, and untreated sewage collects in ponds. The drainage system and structures are in poor condition with open smelly drains and sewers. Drains are in poor condition almost in all the city and need to be repaired.

2. Project Size

According to socio economic survey results 33% (1312 Acres) of city area is served with drainage system. 80% of respondents from the town are dissatisfied with the current sewerage system. Therefore, it is proposed to repair and rehabilitate existing drainage scheme for Khairpur Urban Boundary on priority basis covering. Repair and Rehabilitation of Primary and Secondary Drains and sewerage system components will include the following components;

- Repair of Walls, bed and Top slab of drains, manholes and chambers
- Reconstruction of drains, chambers and manholes were found completely damage
- De-Silting of pipes, chambers, drains and inlet gratings
- Laying of news pipes after replacement of old damage pipes
- Rehabilitation of the disposal stations to upgrade the pumping capacity of the disposal stations

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Project Size	
Population of Khairpur Urban Boundary	331,302
MC Area of City in Acres	7,413
Urban Boundary Area within MC in Acres	3,944
Total Coverage of Sewerage and Drainage in Acres	1,312
Rehabilitation of Sewerage and drainage Network scheme for 33% (1312 Acres) outside of Core Urban Boundary of Khairpur City @ Rate of 0.165 million Per Acre	216.5

3. Project Benefits

After implementing of this project, the overall surface drainage network of Khairpur City with easy disposal to canals after the treatment. Improvement in the Aesthetics / Infrastructure facilities of the Khairpur City.

4. Implementing Authority

Government of Sindh - PHE Department Khairpur MC.

5. Estimated Cost

216.5 million PKR Approx.

C. Construction of Waste Water Treatment Works

1. Project Scope and Justification

Currently, there is no wastewater treatment plant present in Khairpur city. It is recommended to construct at least two wastewater treatment plants with waste stabilization pond for Khairpur City urban boundary 2028.

Waste stabilization pond (WSP) is natural technology which can be installed in centralized or semi-centralized sewerage systems for treatment of domestic and industrial wastewater and sludge, etc. WSPs are highly efficient, simple to construct, low cost and easy to operate.

2. Project Size

Initially, construction of 2 WWTPs having capacity of 3.9 MGD and 5.7 MGD in zone 1 and zone 2 respectively is proposed on priority basis due to be completed in phase wise distribution – Construction activities as per the pollution load of the city.

3. Project Benefits

After the implementation of the planning, wastewater will be used for landscaping or maybe for other use Agricultural fields as a fertilizer.

4. Implementing Authority

Government of Sindh - PHE Department Khairpur MC.

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5. Estimated Cost

1,307 million PKR Approx.

Summary of Proposed Priority Projects – Khairpur City

Sr. No.	Project Name	Estimated Cost in Millions
Sewerage and Drainage		
1	Installation of New Sewerage network for 67% (2632 Acres) of Khairpur city Urban Boundary @ Rate of 1.5 million Per Acre.	3,948
2	Rehabilitation of Sewerage and drainage Network scheme for 33% (1312 Acres) outside of Core Urban Boundary of Khairpur City @ Rate of 0.165 million Per Acre	216.5
3	Construction of 2 Wastewater Treatment Works – Phase wise Construction	1,307

D. Planning Concept for Urban Boundary (2028)

The total projected population of Urban Boundary for year 2028 is 331,302. The total design flow is 76.95 cusec. The diameters use in this urban boundary of 2028 range from 9 Inch diameter RCC pipe to 36 inches diameter RCC Pipe.

Table 8-34, Population of Urban Boundary (2028)

Urban Boundary	Population
	2028
Total Population	331,302

1. Design Flow

Total design flow for the project area is calculated on the basis of design criteria. Based on the agreed criteria, design flow of the city is estimated in **Table** 8-35.

Table 8-35, Design Sewage Flow of 2028

Parameter	Unit	Value
Projected Population	Persons	331,302
Average Water Demand	Cusecs	29.20
Average Domestic Sewage Flow @85% of avg. water demand	Cusecs	24.82
Infiltration @ 10% of average sewage flow	Cusecs	2.482
Peak Sewage Flow	Cusecs	49.64
Storm water Allowance @50% of peak sewage flow	Cusecs	24.82
Total Design Flow	**Cusecs**	**76.95**

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2. Disposal Stations

Presently, there exist Twenty-Six (26) disposal/lift stations in Khairpur city urban boundary. These are used for pumping of the sewage/storm water to the final disposal points. These Disposal stations disposing off the raw sewage into nearby water bodies like Rohri canal and Mirwah canal etc.

Disposal Stations is given in table below:

Table 8-36, Disposal Stations

Sr. No.	Name of Disposal Station	Designed Capacity (cusecs)	Rehabilitation/ Non-Functional/ Under Construction
1	Janwari Goth	1	Non-Functional
2	Allahabad colony	1	Non-Functional
3	Bhutta Gopang	0.5	Non-Functional
4	Faizabad Colony	-	Non-Functional
5	Shahbaz Colony	1.5	Rehabilitation
6	Naveed Colony	1	Rehabilitation
7	Murad Shah	1.5	Rehabilitation
8	Jamali Goth	12	Rehabilitation
9	Maitla	5	Rehabilitation
10	Allahabad new	Under Construction	

3. Wastewater Treatment Plant

The treatment and ultimate disposal of municipal wastewater/sewage of Khairpur city is a major concern. Currently, no treatment plant is available for treatment of sewage in the project area of Khair city. The raw sewage is being directly disposed into the nearby water bodies (Rohri canal and Mirwah canal) or used for agricultural purposes. Three wastewater Treatment Plants (WWTPs) have been proposed for zone 1 and zone 2 of capacity of 3.9 and 5.7 MGD respectively. The treated wastewater from the proposed wastewater treatment plants will discharge into the nearby water bodies.

Note: *All industries shall install and operate their own wastewater treatment plants (WWTPs), and only treated effluent complying with applicable discharge standards shall be allowed to connect to the city trunk sewer system.*

The comparison for wastewater technology is given below:

Parameter	Activated Sludge	Trickling Filters	Aerated Lagoons	Waste Stabilization Pond
Plant Area Requirement	Minimum		High	Very High
Operation and Maintenance Cost	High	Moderate	Very High	Minimum

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Parameter	Activated Sludge	Trickling Filters	Aerated Lagoons	Waste Stabilization Pond
Process Energy Requirement	High	Moderate	Very High	Nil
Operational Supervision & Control	High	High	Moderate	Minimum
Construction Cost	High	High	Very High	Moderate
Capital Cost	High	High	Very High	High
Process Mechanical Equipment	Yes	Yes	Yes	No
Quantities of Sludge Produced	High	High	High	Minimum
Daily Waste Sludge Disposal	Yes	Yes	Yes	No

The Waste Stabilization Pond (WSP) system is a natural and low-cost wastewater treatment option that relies on biological processes driven by sunlight, algae, and microorganisms. It requires large land area but offers significant advantages such as no energy requirement, minimal operation and maintenance, and no need for complex mechanical equipment. The system produces very little sludge, eliminating the need for daily sludge handling or disposal. Due to its simplicity, reliability, and low operational cost, WSPs are particularly well-suited for cities where skilled staff is not available, they cannot meet high operational cost of other treatment technologies and warm climatic conditions like those in Pakistan.

a. Design Capacity

- WWTP 1: 3.9 million Gallons per Day (MGD)
- WWTP 2: 5.7 million Gallons per Day (MGD)

b. Components of Treatment Technology

Anaerobic Ponds

- **Function:** Initial treatment to settle solids and reduce organic load.
- **Depth**: 3–5 meters
- **Retention Time:** 1–5 days

Facultative Ponds

- **Function:** Biological treatment using aerobic and anaerobic bacteria and algae.
- **Depth:** 1–2.5 meters
- **Retention Time:** 5–30 days

Maturation Ponds

- **Function:** Final polishing to remove pathogens.
- **Depth:** 0.5–1.5 meters
- **Retention Time**: 5–10 days

Treatment Efficiency

- **BOD Removal:** 80–95%
- **COD Removal:** 80-85%
- **Pathogen Removal:** 90–99%
- **TSS Removal:** 80–90%

Treated effluent is suitable for restricted irrigation or safe discharge to surface waters.

c. Area Estimation for Treatment Plant

Area needs depend on flow rate, design parameters, and retention times. The following are typical estimates based on standard WSP design:

3.9 MGD WSP

- Flow Rate: ~ 17,724 m^3/day
- Total Area Required: 26.6 Hectare

(Assuming 1.5 hectare per 1,000 m^3 /day for full WSP train)

5.7 MGD WSP

- Flow Rate: ~ 25,904 m^3/day
- Total Area Required: 38.9 Hectares

Effluent of all treatment plants should be compiling with NEQS standards before discharge.

Critical Parameter	Standard as per NEQS (mg/L unless noted)
pH	6-10
Biochemical Oxygen Demand (BOD5) at 20∘C	80
Chemical Oxygen Demand (COD)	150
Total Suspended Solids (TSS)	150
Total Dissolved Solids (TDS)	3500
Oil and grease	10
Phenolic compounds (as phenol)	0.1
Cyanide (as CN) total	2
Total toxic metals	2

d. Suitability of Treatment Technology Adopted

For Khairpur city, it is recommended to:

- Use a phased construction plan, prioritizing one plant and expanding as demand grows.
- Explore integration with constructed wetlands for final polishing and reuse

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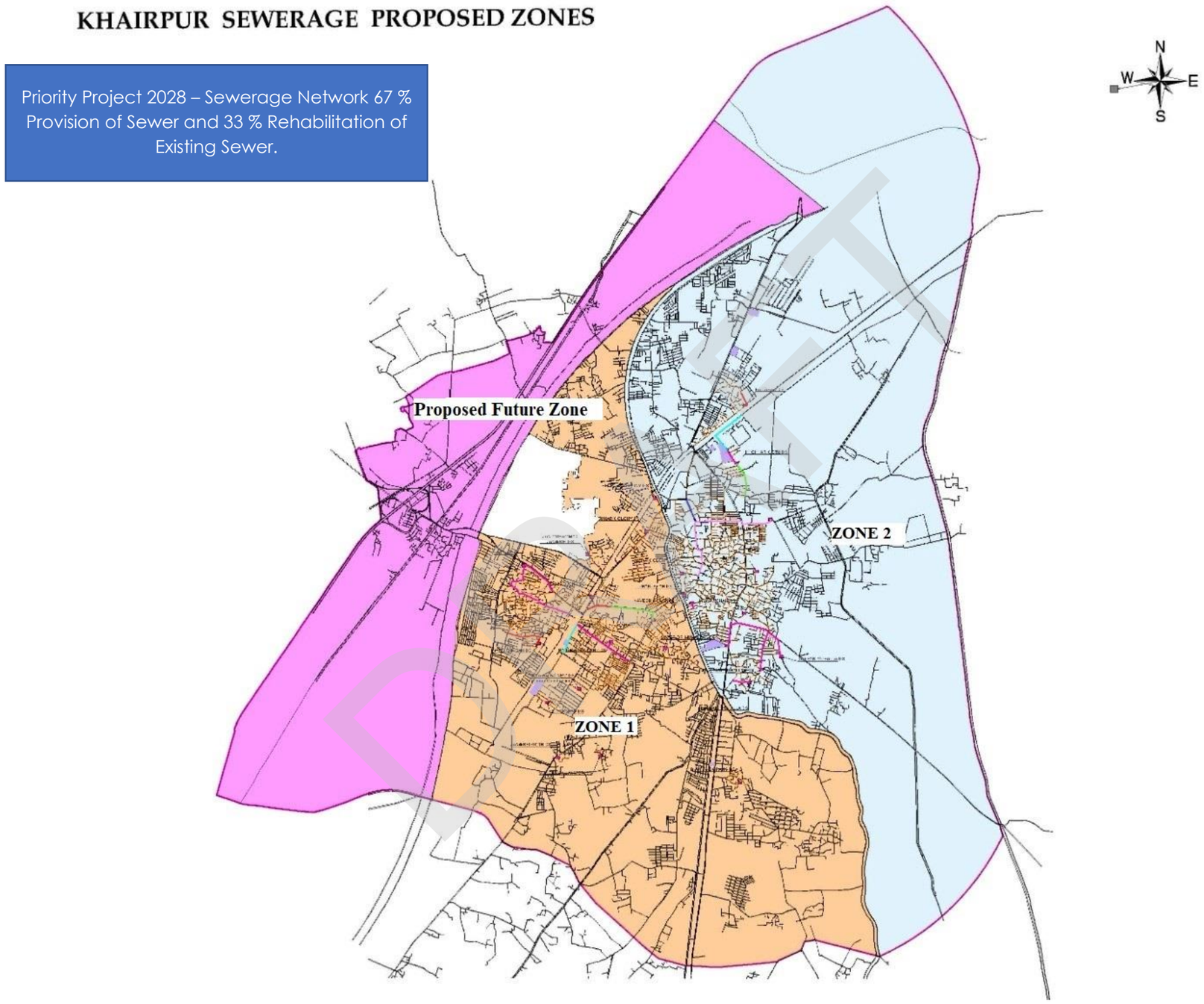


Figure 8-13, Priority Project Sewerage Network of Khairpur

Source: *The Consultant Team*

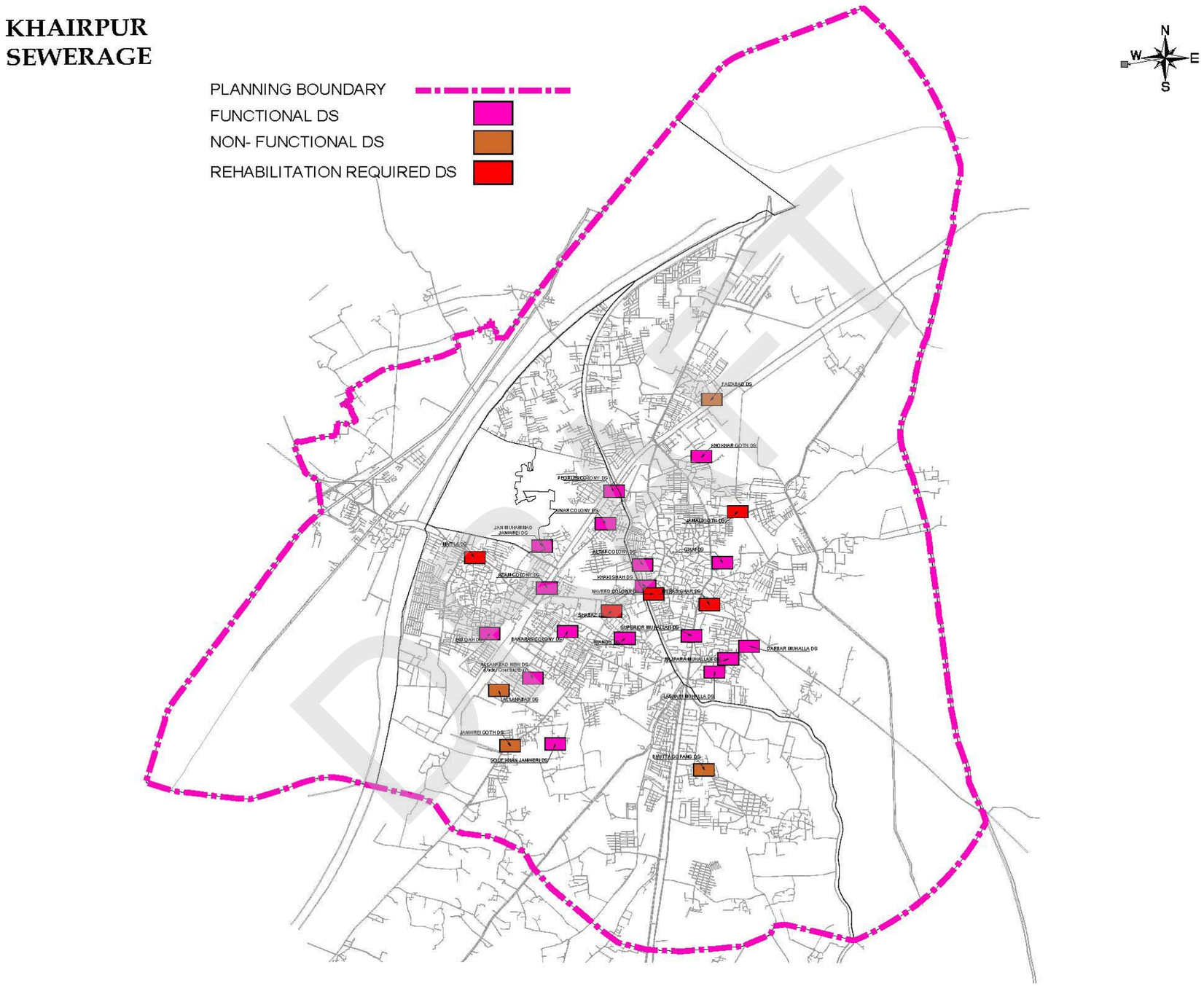


Figure 8-14, Sewerage Network of Khairpur

Source: *The Consultant Team*

8.3.7 Immediate Action Plan for Core Urban Area

According to the information provided by the Municipal Committee and consultant survey the sewerage and drainage system of Khairpur city consist of underground pipe sewers constructed in various phases along with a huge network of small sized drains in the streets. The sewerage/wastewater gravitates to the covered or open surface drains.

Table 8-37, Demand and Flow for Khairpur Core Urban Boundary

	Description	2025
Khairpur City	Population	182,311
	Water Demand (Cusec)	16.07
	Design Flow (Cusec)	42.34

Source: *Consultant's Estimation*

A. Repair and Rehabilitation of Sewerage and Drainage Network Core Area

During the survey the residents complained that, the design of existing sewerage and drainage network is not fulfilling the present demand. And old sewerage line which had burst several times. So therefore, it is proposed to repair and rehabilitate existing sewerage and Drainage network of core city area.

S. No.	Name	Total Core Urban Area (acre)	Per acre cost (PKR) million	Cost (PKR) million
1	Sewerage System	2,264	0.165 million per acre	373.5
Total Cost (PKR). Million				**373.5**

Note: *Sewerage system includes all urban core area network system with all related machinery and equipment.*

Table 8-38, Break Up Plan for Rehabilitation of Sewerage Pipes

Sr. No.	Priority Project List for Sewerage in Core Urban Area	Length (Rft)
KHP-P-01	Rehabilitation of Jamali Goth Disposal Station and providing 2 No pumps of 4 cusecs.	-
KHP-P-02	Rehabilitation of Unar Colony Disposal Station and Rehabilitation of Wet Well	-
KHP-P-03	Rehabilitation of Maitla Disposal Station (Repair of damaged pump room and screening chamber)	-
KHP-P-04	Desilting of Noral Drain near Jamali Goth DS	2,115
KHP-P-05	Replacement of under capacity 36 inches RCC pipe with 42 inches RCC Pipe, at Maryam Toop Chowk up to Jamali Goth Disposal Station	1500
KHP-P-06	Replacement of under capacity 18 inches RCC pipe with	1,165

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Sr. No.	Priority Project List for Sewerage in Core Urban Area	Length (Rft)
	24 inches RCC Pipe, at Civil Hospital Road up to Banaras Colony Disposal Station	
KHP-P-07	Replacement of under capacity 12 inches RCC pipe with 15 inches RCC Pipe up to Cheeni Chowk	400
KHP-P-08	Replacement of under capacity 15 inches RCC pipe with 18 inches RCC Pipe, from Cheeni Chowk up to Lambur Athar Chowk	1,120
KHP-P-09	Replacement of under capacity 18 inches RCC pipe with 24 inches RCC Pipe, from Lambur Athar Chowk up to Maitla Disposal Station	1,850

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Water demand = 36 gallons per capita per day																					
Wastewater Generation = 85% of water demand = 30.6 gallons per capita per day																					
Sr. No.	Disposal Stations	Length	Population of Subcatchment Areas			Avg. daily sewage flow		Infiltration	Peak Factor	Peak dry weather flow	Storm water allowance 50%	Q check		Design flow Qa	Cumalative Design Flow	V full Check	V full	Adopted Dia		Existing Diameter	
		ft	Population Density	Sub-catchment Areas (Hectares)	Population	GPD	Cusecs	Cusecs		Cusecs	Cusecs	Adopted Dia	Existing dia	Cusecs			fps	inches	ft	ft	inches
1	Faizabad	1101	80	22.3	1784	45492	0.084	0.008	2	0.168	0.084	OK	OK	0.261	0.261	OK	2.51	12.00	1.00	1	12
2	Naveed Colony	2566	80	13	1040	26520	0.049	0.005	2	0.098	0.049	OK	OK	0.152	0.152	NOT OK	1.94	12.00	1.00	1.5	18
3	Lashari Muhalla	3490	80	11.7	936	23868	0.044	0.004	2	0.088	0.044	OK	OK	0.137	0.137	NOT OK	1.94	12.00	1.00	1.5	18
4	Darbar Muhalla	3554	80	9.9	792	20196	0.037	0.004	2	0.075	0.037	OK	OK	0.116	0.116	NOT OK	1.94	12.00	1.00	1.5	18
5	Rajpar Muhalla	3859	80	6.46	516.8	13178.4	0.024	0.002	2	0.049	0.024	OK	OK	0.076	0.076	NOT OK	1.94	12.00	1.00	1.5	18
6	Superior Muhalla		80	15.3	1224	31212	0.058	0.006	2	0.115	0.058	OK	OK	0.179	0.179	NOT OK	1.94	12.00	1.00	1.5	18
7	Eid Gah		80	22.2	1776	45288	0.084	0.008	2	0.168	0.084	OK	OK	0.260	0.260	OK	2.51	12.00	1.00	1	12
8	Khokhar Goth		80	12.9	1032	26316	0.049	0.005	2	0.097	0.049	OK	OK	0.151	0.151	OK	3.07	12.00	1.00	0.75	9
			80	5.7	456	11628	0.022	0.002	2	0.043	0.022	OK	OK	0.067	0.218	NOT OK	1.94	12.00	1.00	1.5	18
			80	6	480	12240	0.023	0.002	2	0.045	0.023	OK	OK	0.070	0.070	OK	3.07	12.00	1.00	0.75	9
			80	3.2	256	6528	0.012	0.001	2	0.024	0.012	OK	OK	0.037	0.108	NOT OK	2.20	12.00	1.00	1.25	15
9	Jamali Goth		80	14	1120	28560	0.053	0.005	2	0.106	0.053	OK	OK	0.164	0.164	NOT OK	1.59	12.00	1.00	2	24
			80	20	1600	40800	0.075	0.008	2	0.151	0.075	OK	OK	0.234	0.398	NOT OK	1.37	12.00	1.00	2.5	30
			80	21.3	1704	43452	0.080	0.008	2	0.161	0.080	OK	OK	0.249	0.249	NOT OK	1.59	12.00	1.00	2	24
			80	83.6	6688	170544	0.316	0.032	2	0.631	0.316	OK	OK	0.978	1.789	NOT OK	1.21	12.00	1.00	3	36
10	Maitla		80	4	320	8160	0.015	0.002	2	0.030	0.015	OK	OK	0.047	0.047	OK	2.51	12.00	1.00	1	12
			80	14.9	1192	30396	0.056	0.006	2	0.112	0.056	OK	OK	0.174	0.221	NOT OK	2.20	12.00	1.00	1.25	15
			80	9.3	744	18972	0.035	0.004	2	0.070	0.035	OK	OK	0.109	0.330	NOT OK	1.94	12.00	1.00	1.5	18
			80	25.3	2024	51612	0.095	0.010	2	0.191	0.095	OK	OK	0.296	0.296	NOT OK	1.94	12.00	1.00	1.5	18
11	Shabbaz		80	8.3	664	16932	0.031	0.003	2	0.063	0.031	OK	OK	0.097	0.097	OK	2.51	12.00	1.00	1	12
			80	21.8	1744	44472	0.082	0.008	2	0.165	0.082	OK	OK	0.255	0.352	NOT OK	2.20	12.00	1.00	1.25	15
12	Banaras		80	4.7	376	9588	0.018	0.002	2	0.035	0.018	OK	OK	0.055	0.055	OK	3.07	12.00	1.00	0.75	9
			80	38.4	3072	78336	0.145	0.014	2	0.290	0.145	OK	OK	0.449	0.504	NOT OK	1.94	12.00	1.00	1.5	18

Figure 8-15, Load Assessment of Disposal Stations

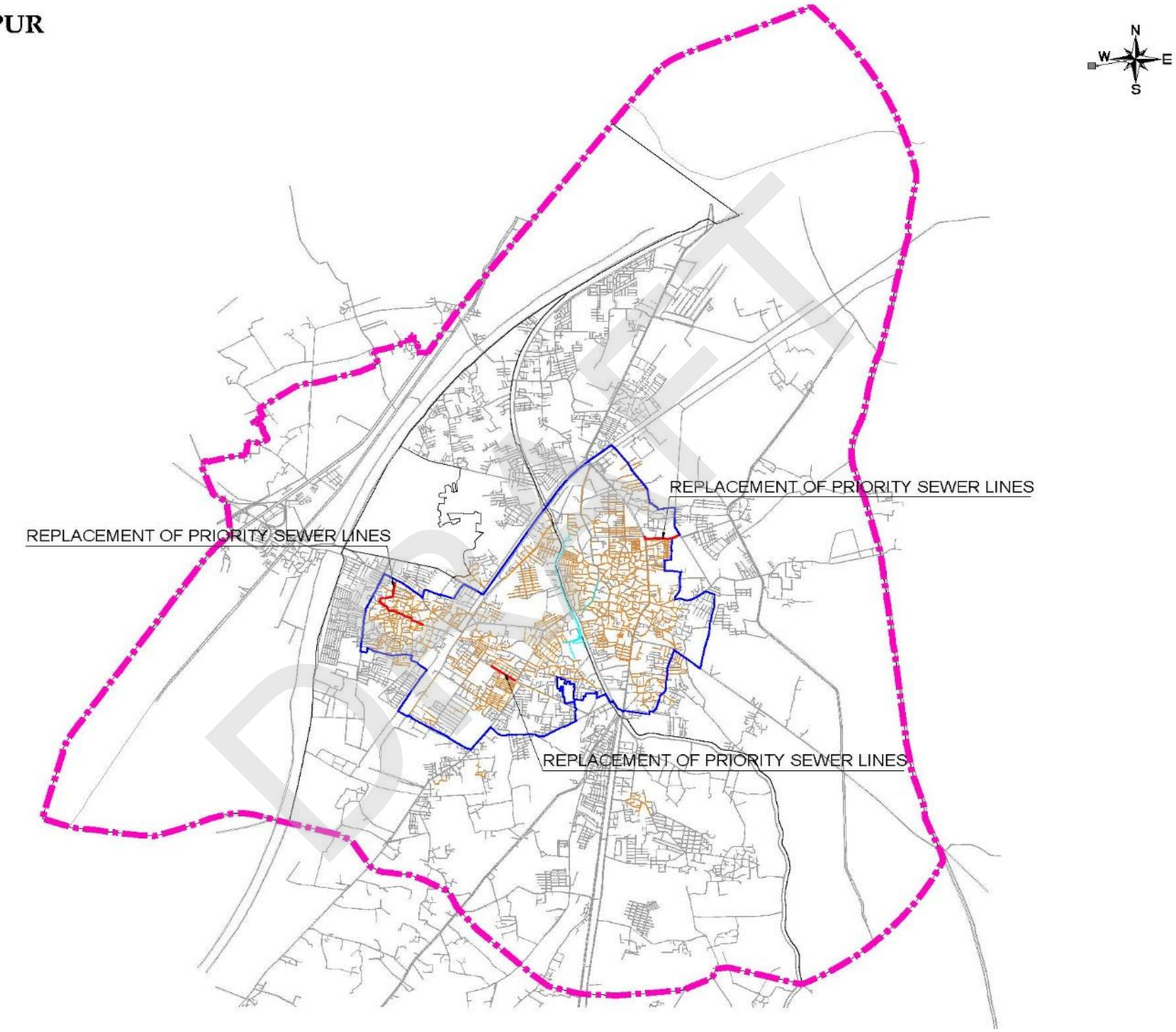


Figure 8-16, Replacement of Priority Sewer Lines

Source: *The Consultant Team*

B. Planning Concept of Core Urban Area

The total projected population of Core Urban for year is 182,311. The total average demand is 16.07 cusec. The design flow is 42.34 cusec. The diameters use in this zone range from 9 Inches diameter RCC Pipe to 27 Inches diameter RCC Pipe.

Table 8-39, Population of Core Urban Boundary

Core Urban	Population
	2025
Total Population	182,311

1. Design Flow

Total design flow for the project area is calculated on the basis of design criteria. Based on the criteria, design flow of the city is estimated in **Table** 8-40.

Table 8-40, Design Flow of 2025

Parameter	Unit	Value
Projected Population	Persons	182,311
Average Water Demand	Cusecs	16.07
Average Domestic Sewage Flow @85% of avg. water demand	Cusecs	13.66
Infiltration @ 10% of average sewage flow	Cusecs	1.366
Peak Sewage Flow	Cusecs	27.32
Storm water Allowance @50% of peak sewage flow	Cusecs	13.66
Total Design Flow	**Cusecs**	**42.34**

2. Disposal Stations

Presently, there are 4 disposal/lift stations in Khairpur city core urban boundary. These are used for pumping of the sewage/storm water to the final disposal points. These Disposal stations disposing off the raw sewage into nearby water bodies like Rohri canal and Mirwah canal etc.

Disposal Stations is given in following table:

Table 8-41, Disposal Stations Requiring Rehabilitation to enhance Pumping Capacity

Sr. No.	Name of Disposal Station	Designed Capacity (cusecs)	Rehabilitation
1	Ghai	4	Rehabilitation
2	Jamali Goth	12	Rehabilitation
3	Khaki Shah	6	Rehabilitation
4	Azam Colony	2	Rehabilitation

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8.4 Solid Waste Management

8.4.1 Existing Situation

A comprehensive situational analysis of Ghotki City has been conducted to assess the current circumstances, identify key challenges, and evaluate the effectiveness of existing systems in place. This analysis provides a clear understanding of the city's waste management issues, infrastructure limitations, and operational inefficiencies, offering valuable insights for the development of targeted solutions and strategic interventions.

Based on the current waste management scenario, several critical gaps have been identified that necessitate the formulation of a Strategic Development Plan. The city generates approximately 66 tons of waste daily from diverse sources, including residential, commercial, industrial, and construction sectors. However, only 38% of this waste is efficiently collected due to inadequate equipment efficiency, high operating costs, and insufficient manpower. Transportation challenges exacerbate the issue, with outdated and inefficient machinery consuming excessive fuel and time while offering minimal service efficiency. Furthermore, the shortage of sanitation manpower and vehicle operators has severely limited the city's ability to achieve targeted waste management outcomes. Open dumping sites within city limits further compound the problem, posing significant health hazards, environmental degradation, and mental stress for residents. Addressing these critical gaps requires a well-structured and sustainable strategic development plan to enhance waste management operations and improve the quality of life for the city's inhabitants.

A. Summary of Existing Resources

The following human resources, tools and equipment, and machinery resources are already available in the city to conduct regular solid waste management operations.

1. Machinery, Tools, Equipment, and Dump Site Machinery

Table 8-42, List of Existing Machinery, Tools, Equipment, and Dump Site Machinery

Equipment/machinery	2023	
	Operational	Gap
Hand carts (0.25 m3)	11	19
Mini Tipper (01 m3)	0	10
Containers (0.8 m3)	6	10
Mobile Compactor (8.0 m3)	0	02
Front blade tractors	0	01
Tractor trolleys	06	30

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Equipment/machinery	2023	
	Operational	Gap
Arm roll truck (5.0 m3)	01	01
Front end loaders	02	01
Water bowser with tractor	01	01

2. Human Resources

Table 8-43, Existing Human Resources

Year		Sanitary workers	Vehicle Drivers	Supervisors	Sanitary Inspectors	Clerks	Other Staff
2023	Available	172	05	00	00	01	00
	Gap	40	07	07	02	01	03

B. Solid Waste Generation as per Population Projection

To calculate the future equipment and machinery demands, it is required to calculate annual solid waste generation for the given years. The waste generation estimations are based on the population for each respective year.

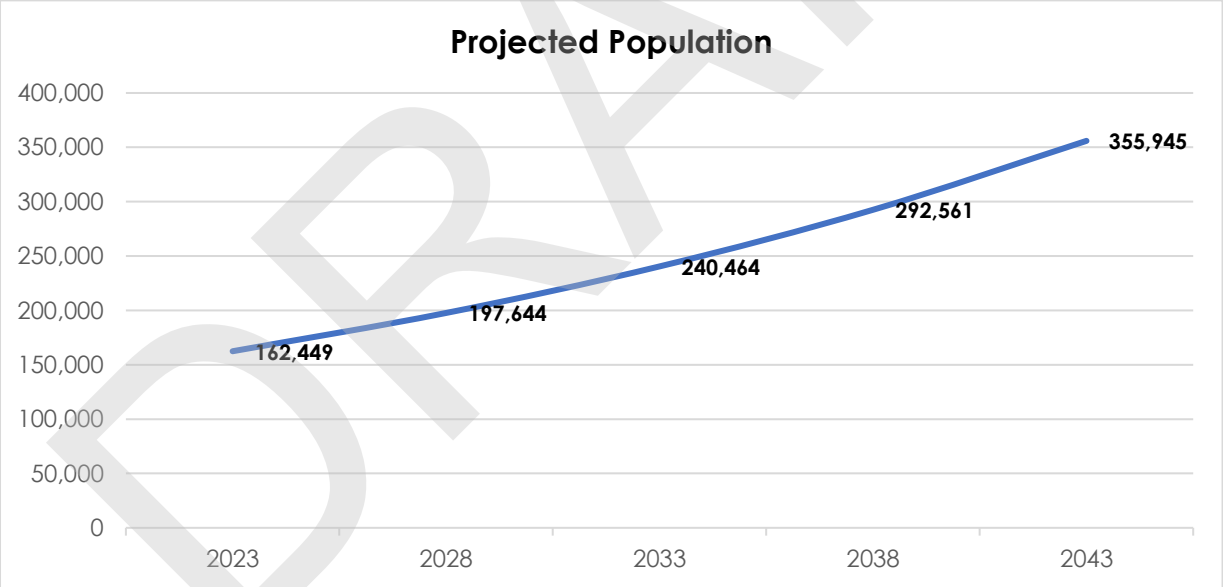


Figure 8-17, Population Projection

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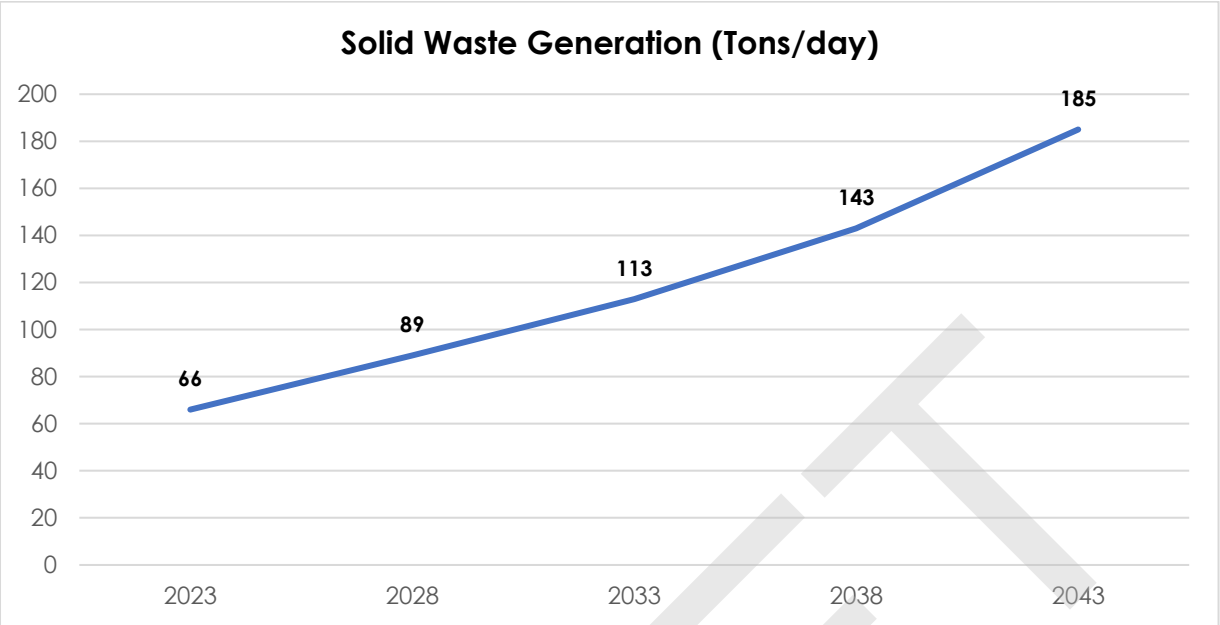


Figure 8-18, Solid Waste Generation

8.4.2 Issues and Gap Analysis

Table 8-44, Issues/Gap Analysis of the city SWM

Areas	Gaps/Issues identified
Waste Generation	According to 2023, 66 tons/day waste is being generated. This huge amount of waste is generated either from residential, commercial, industrial areas as well as from construction and demolition waste.
Collection	According to 2023 solid waste generation, the total waste collection efficiency is 38%. Municipal solid waste collection lacks 62% of waste collection efficiency due to Poor efficiency of equipment and machinery Large operating cost Insufficient man power
Transportation (Equipment and Machinery)	The existing equipment and machinery are being operated at its full capacity but still it is not possible to attain full-service efficiency due to low efficiency of equipment consuming larger time and money in its operation. The tractors trolleys are slow moving and consuming large fuel & time but carry only one third of the waste to dumping sites as compared to the compactor trucks. Similarly, the container carriers haul only one container carrying 3.0 m3 of waste to the dumping site. These carriers are also hauled by tractors having slow speed, high fuel consumption and very low efficiency. The proposition of continued use of this equipment with enhanced number of manpower will not cure the problem. Rather it will increase the operation and maintenance cost with very little improvement of the service delivery level.

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Areas	Gaps/Issues identified
	Both of these secondary collection systems are having poor efficiency and also require larger manpower as compared to the existing.
Manpower	MC Ghotki is facing sanitation manpower shortage for rendering services to the entire city. For accruing the targeted benefits from the project. Vehicle drivers and other allied staff need to be recruited by MC for which sanction of the competent authority is required. Present ban on the recruitment needs to be filled for this recruitment.
Disposal	The present open dumping sites are located in the city and are big health hazards for the inhabitants as these are breeding vectors, producing obnoxious smell, deteriorating and degrading the city environment and producing large mental frustration. MC will continue to dump the waste in the present dumping sites.

8.4.3 SWOT Analysis

To effectively cope with the challenges of providing municipal services of the city, a detailed analysis on strengths, weaknesses, opportunities, and threats (SWOT) was carried out to assess possible weaknesses and potential threats in the execution of service provision, so as to devise a plan of action to overcome these, utilising present strengths and available opportunities. These are explained below:

STRENGTH	WEAKNESSES
Institutional and Financial • Management – An organizational structure for SWM of the city is available • Health and Safety – Provisions in the Manuals to safeguard employees • Capability – Available vacant positions for sanitary workers, vehicle driver and sanitary inspectors and clerk • Motivation- Compliant cell is available to ensure SWM operations in proper legal and ethical way • Financial Management – Financial Systems in place • Monitoring – Monitoring is carried out by Local Government and District Administration	**Institutional and Financial** • Management: -Insufficient strategic approach for SWM & Political influence at the organizational level • Staff –Insufficient sanitation workers to cover the entire city • Health and Safety – Disposal sites are not too far from the city (05 & 04 km approximately), causing health implications • Capability - Lack of staff capability • Motivation- no proper disposal of complaints • Financial Management – No financial resources available for environmental management

STRENGTH	WEAKNESSES
Solid Waste Operations • Coverage – 38% door to door collection and Street Sweeping is carried out on main roads and bazar • Data- Systems available and real-time system adopted by SWMC • Parking and Storage – Sufficient number of available machinery and equipment • Workshop – Can maintain a vehicle for minor repairs • Fleet Capacity –Sanitation workers of the city work in two shifts • Waste Containers – Street Sweeping is carried out on main roads and bazar • Disposal Facility-Sharing of a single solid waste storage area i.e., dumping sites • Route Planning-Proper Route planning	system and cleaner production • Monitoring – Monitoring without KPIs **Solid Waste Operations** • Data-Lack of data base for tracing of vehicles • Parking and Storage facility – one disposal site almost filled and closed • Workshop – Need maintenance/repair of tractor trolleys, containers, front end loaders and dumper • Fleet Capacity – Lack of sanitation manpower to cover the entire city (collection efficiency is 38%) • Waste Containers - No 3-bin system is installed • Transfer Stations – Not available nor Time and motion study conducted • Disposal Facility – No engineering-controlled landfill site is available in the city • Taxation-Lack of Solid Waste taxation • Treatment – Un-availability of solid waste treatment technologies • Route Planning-Lack of route optimization

OPPORTUNITIES	THREATS
Institutional and Financial • Management – To fill the positions and make use of the available tiers • Staff – Increase in employment opportunities • Health and Safety – Reduce health risks (water borne diseases) & Maintaining cleanliness for creating a positive ambiance and promoting good health • Capability - Can be enhanced by	**Institutional and Financial** • Management: Decision not given due consideration due to lack of qualified staff • Staff – Work overladed to nontechnical staff • Health and Safety – Staff exposed to a range of hazards thus vulnerable • Capability – Insufficient awareness of the public

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OPPORTUNITIES	THREATS
filling the vacant posts • Motivation- Improvement in country's economy • Financial Management – Regularized and implementing terrif • Monitoring – Proper KPIs for monitoring can increase efficiency **Solid Waste Operations** • Data- Systems available and real-time system adopted by SWMC • Parking and Storage – Places marked and budget for construction • Workshop – By Upgrading vehicles can be maintained for all purposes • Fleet Capacity – Adequate for next 7 years • Waste Containers – Workshop may include manufacturing and repairing containers • Transfer Stations – Promoting resource recovery and composting for sustainable waste management • Disposal Facility –Engineered Landfill Site can be established • Treatment – Implementing circular economy principles to reduce solid waste and promote recycling &Installation of a biogas plant in a solid waste management center • Route Planning – Upgradation of Routes can increase efficiency	regarding solid waste management • Motivation- Poor corporation from residents (specially entrepreneurs) • Financial Management – Overbilling, under billing and nonproductive results • Monitoring – Satisfaction without due consideration leading to no improvement **Solid Waste Operations** • Data- No backups • Parking and Storage – Vehicle parts theft and cleanliness • Workshop – Cost of repairs rising • Fleet Capacity – Low amounts of On-road vehicles • Waste Containers - Theft /Non-maintenance causing a decrease in collection capacity • Transfer Stations. – The increasing cost of waste transportation • Treatment – Low value of recyclable solid waste • Disposal Facility – Lack of control over disposal sites operations • Route Planning - High cost for Waste Collection • Extreme weather events due to climate change can disrupt solid waste management systems and create additional challenges

8.4.4 Need Assessment and Policy Guidelines

Need Assessment	Relevant Policy Guidelines
Need for effective waste management strategies to handle 66 tons/day of waste	**Sindh Solid Waste Management Board Act, 2014:** Empowers the collection and disposal of solid waste, supports and promotes waste management schemes, and regulates waste generation and disposal.
Improve waste collection efficiency	**Sindh Local Government Ordinance, 2013:** Endorses the management,

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Need Assessment	Relevant Policy Guidelines
	operation, and maintenance of sanitation disposal and solid, liquid, industrial, and hospital waste collection.
Upgrade inefficient collection equipment and machinery	**Sindh Solid Waste Management Board Act, 2014:** Allows for the improvement, maintenance, and construction of machinery and related infrastructure for waste management.
Increase manpower for waste collection and enhance their safety	**Sindh Occupational Safety and Health Act, 2017:** Provides a framework for safe working conditions, which supports the recruitment and safety of sanitation workers.
Modernize or replace low-efficiency transportation equipment	**Sindh Solid Waste Management Board Act, 2014:** Authorizes the improvement and maintenance of machinery, enhancing transportation efficiency for waste management.
Explore cost-effective and fuel-efficient transportation solutions	**Sindh Solid Waste Management Board Act, 2014:** Supports the implementation of efficient waste management schemes, including transportation.
Redesign secondary collection systems to reduce manpower needs	**Sindh Local Government Ordinance, 2013:** Encourages the improvement of waste collection systems under local government regulation.
Recruit additional sanitation workers	**Sindh Occupational Safety and Health Act, 2017:** Establishes a framework for recruitment and safety in workplaces, relevant for expanding the sanitation workforce.
Lift recruitment ban to address manpower shortages	**Sindh Occupational Safety and Health Act, 2017:** Supports consultations between workers, employers, and government, which can influence decisions on lifting recruitment bans for necessary staffing.
Relocate dumping sites away from residential areas	**Sindh Environmental Protection Act, 2014 (SEPA 2014):** Provides the legislative framework for environmental protection, including the location and management of dumping sites.
Implement safe and environmentally friendly waste disposal methods	**The Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2014:** For

Need Assessment	Relevant Policy Guidelines
	landfill/leachate/MRF, include an EIA/IEE pathway, EMP with monitoring, and budget for environmental controls; tie construction start to NOC issuance in the phasing plan.
Implement safe disposal methods for hospital waste	**Sindh Hospital Waste Management Rules, 2014:** Mandates hospitals to manage waste using internationally or nationally recognized practices, ensuring safe disposal.
Handling and disposal of hazardous substances	**Hazardous Substance Rules, 2014**: Provides regulations for handling, storage, and disposal of hazardous substances, including waste management plans and safety precautions.

8.4.5 Strategic Development Plan

The initial assessment has already been conducted through stakeholder engagement, as presented in Section 1.1 of this report. The subsequent steps of the strategic plan are outlined below:

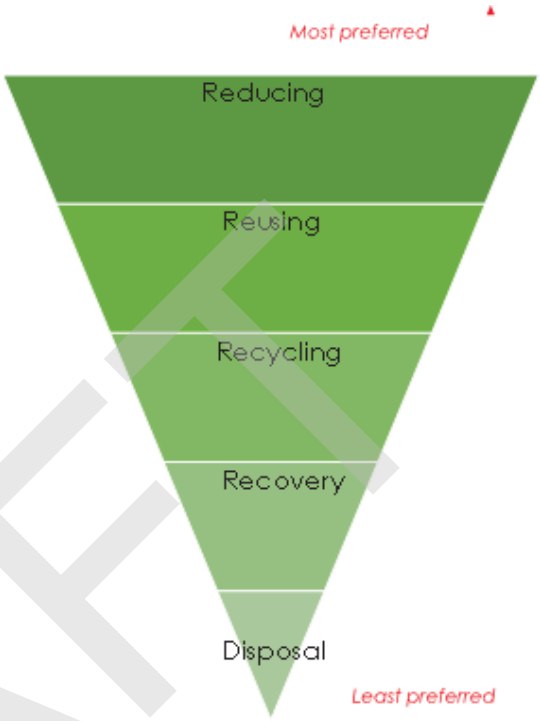
A. Vision and Goal Setting

In order to address the weaknesses and threats as mentioned in the SWOT analysis, MC has developed a SSWMP 2023-2043 for the city in order to establish, a resource recycling, financially sustainable and environmentally sound waste management system in the city. SSWMP includes a comprehensive list of priority projects including actions and implementation based on the existing situational analysis conducted through quick study and series of workshops and meetings on strategy development.

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B) Waste Management Hierarchy

The waste management hierarchy as shown, is widely referred to in promoting the 3Rs concept, or Reduce – Reuse – Recycle. Accordingly, the most preferred option in the waste hierarchy is to prevent the waste being generated at the outset, and the next preferred option is to reduce amounts generated. Likewise, the least preferred option is the final disposal, which should be practiced only after attempting to implement the other preferred strategies.



The first step of the SSWMP is to establish the priorities whereas the next step of the plan is to provide broad guidelines to suggest measures to manage the growing solid waste of the city. This has been determined after assessing the potentials and constraints in the existing solid waste management of the city. The plan is prepared with 20 years perspective from year 2023 to year 2043. This section of the report deals with an outline of proposals regarding;

- Action plans to cater for needs of present and future population in municipal services.
- Capacity building for O&M of the municipal services is also proposed in these Action Plans.

According to the developed vision, the following strategic objectives are to be achieved:

- Attain the required institutional and human capacity and reduction in the amount of waste to achieve 100% waste collection efficiency in coordinated, integrated and transparent manner.
- A comprehensive and sustainable approach towards improving waste collection, storage, transfer, disposal and treatment, including hazardous waste must be implemented in the shape of an action Plan.
- Installation of additional and appropriate tools and vehicles to regularized and equitable house-to-house waste collection, community storage, transfer and disposal.
- Availability of financial resource for environmental management system and cleaner production.

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C) Timeframe and Phased Implementation

The strategy will be rolled out in five sequential phases, each of five years, scaled to the realities of Ghotki. A deliberate spatial break-up anchors works where they deliver the greatest early gains, eases management and contractor oversight, and creates clear hand-offs into the next phase. This staging also enables proactive financial planning—with predictable capital and O&M needs defined ahead of each tranche—while progressively upgrading to higher, technically enhanced service levels. Each phase will remain adaptive, allowing design and implementation to evolve with on-ground conditions, demand growth, institutional capacity, and lessons learned from the preceding phase.

D) Proposed Management Structure

A clear management structure keeps city solid-waste services coordinated, accountable, and safe. It defines:

- Who plans, operates, regulates, and pays; preventing gaps and enabling performance-based contracting and safe informal-sector integration.
- Rapid decisions and emergency response, ensures legal compliance (Sindh EPA/SSWMB), and protects workers and communities.
- It centralizes community engagement and GRM, improves data flow and audits, and drives continuous improvement from segregation to final disposal.

A structured management plan, roles/responsibilities, and coordination between various sectors is shown below:

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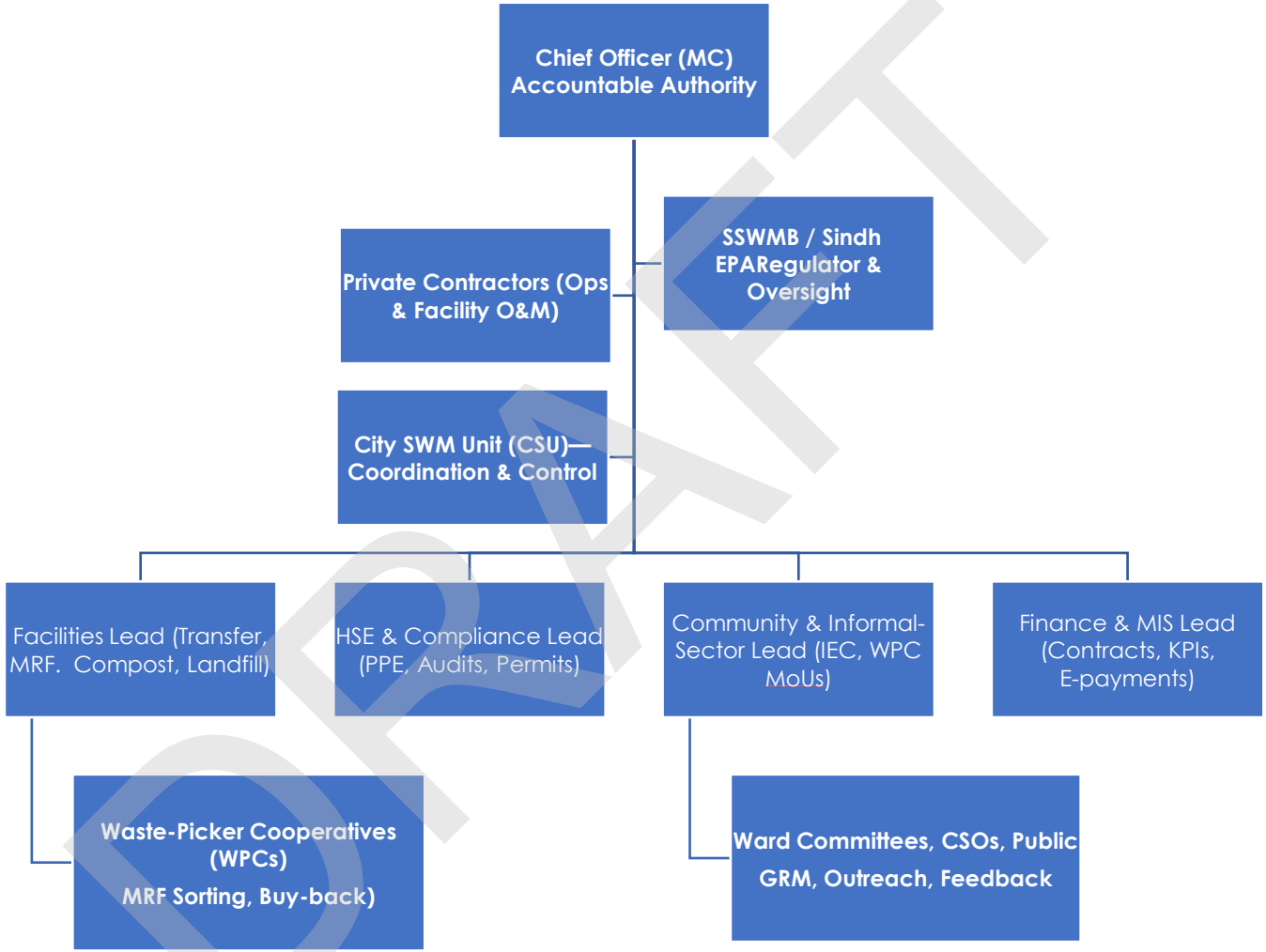


Figure 8-19, Proposed Management Structure - SWM

Source: *The Consultant Team*

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Under the Chief Officer (MC), the City SWM Unit (CSU) coordinates all services while SSWMB/Sindh EPA provide regulatory oversight. Private contractors handle collection, transport, and facility O&M (transfer/MRF/compost/landfill) under performance-based SLAs, reporting to CSU Ops/Facilities; HSE & Compliance lead joint inspections and incidents. The Community & Informal-Sector Lead formalizes WPCs and manages IEC/GRM; Finance & MIS aggregates GPS/weighbridge/e-manifest data for KPI dashboards and payment certification. Weekly O&M huddles, monthly reviews, and CSU→Chief Officer escalation keep field work, compliance, community input, and finance aligned for end-to-end accountability.

E) Provision of Solid Waste Management Resources for future solid waste management

To calculate the future equipment & machinery and manpower, it is required to calculate annual solid waste generation for the given years based on population projection and land use. The proposed urban structure of the city and population projection are given below:

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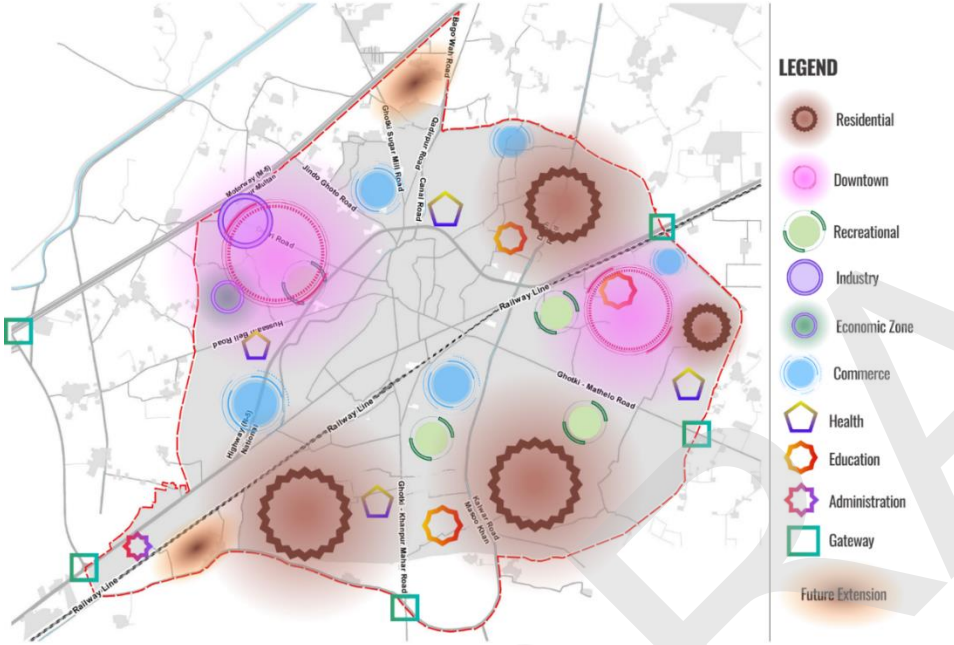
	Land uses	Existing Percentage Distribution	Proposed Percentage Distribution
	Residential	51%	40%
	Commercial	8%	8%
	Parks and Playgrounds	1.42%	20%
	Amenities	6.3%	10%
	Industrial	7%	7%
	Transportation	13.5%	15%
	Other	12.8%	-
	Total	**100%**	**100**

Figure 8-20, Proposed Urban Structure of the City

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The waste generation estimations are based on the population for each respective year.

1. Conversion of daily waste generation to annual waste generation.
2. Estimation of the number of each type of equipment needed based on their average capacity.

Table 8-45, Population Growth in Different Census Periods and Estimated Solid Waste Generation

Year	Projected Population	Population Increase	Waste generation (Tons/day)
2023	162,449	-	66 (as per existing baseline)
2028	197,644	35195	89
2033	240,464	42820	113
2038	292,561	43002	143
2043	355,945	63384	185

**0.42 kg/capita/day*

***0.45 kg/capita/day*

****0.47 kg/capita/day*

*****0.49 kg/capita/day*

******0.52 kg/capita/day*

(Assuming a nominal per capita increase in MSW generation of 01 percent per annum or two)

8.4.6 Equipment And Machinery

With the increase in solid waste generation, it is essential to scale up our machinery and equipment as well as the maintenance of the available resources. This expansion will ensure we can efficiently handle the rising waste volume and maintain effective waste management practices.

Assuming each equipment operates 300 days a year for calculation purposes:

$$\text{Number of Equipment} = \frac{\text{Annual Waste Volume}}{\text{Capacity/ equipment *trips/year}}$$

Table 8-46, Total estimated machinery requirement for the city with 20 years interval throughout the project life i.e., 2043

	Additional Requirement					
Equipment/machinery	2023		2028	2033	2038	2043
	Operational	Gap				
Hand carts (0.25 m^3)	11	19	44	71	109	170
Mini Tipper (01 m^3)	0	10	22	36	55	85
Containers (0.8 m^3)	6	10	37	60	91	141

	Additional Requirement					
Equipment/machinery	2023		2028	2033	2038	2043
	Operational	Gap				
Mobile Compactor (8.0 m³)	0	02	06	09	14	21
Front blade tractors	0	01	03	04	05	06
Tractor trolleys	06	30	48	61	77	100
Arm roll truck (5.0 m³)	01	01	03	13	04	04
Front end loaders	02	01	04	06	07	08
Water bowser with tractor	01	01	03	05	07	09

A. Mechanical Sweeping and Washing

1. Mechanical Sweeping

The Mechanical Sweeper will operate on the major roads for 6 hours daily, covering a minimum distance of 20 kilometers daily. This operation must ensures that the main roads remain clean and debris-free, contributing to a cleaner urban environment. The sweeper will follow a scheduled route, focusing on high-traffic areas and key locations within the municipality to maximize efficiency and effectiveness.

2. Mechanical Washing

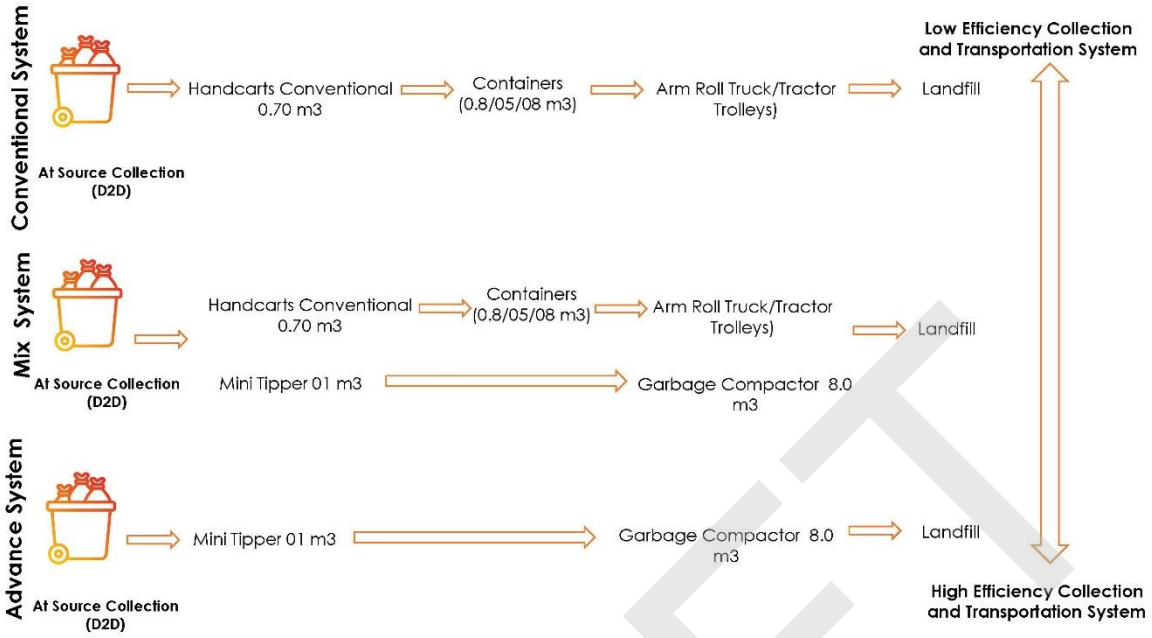
Mechanical washing is another important component of a waste management system. Public places, major roads, dividers, and walkways will be washed to improve their cleanliness. It is proposed to wash/sprinkle the major roads as specified below (min. 05 KM daily per 01 tractor-mounted water bowser/washer) and the walkways of the tehsil through washers to improve their working efficiency and cleanliness standards.

3. Manual Sweeping & Drain Desilting Operations

A dedicated team of sanitary workers equipped with necessary operational tools will manually sweep the area and de-silt the tertiary drains. One drain cleaner will also be deployed separately in urban and rural areas.

- Manual sweeping in the first shift is carried out from 6 AM to 2 PM.
- The tertiary drains will be de-silted and opened 2 feet wide, and one drain cleaner will be deployed separately for urban and rural areas.
- Personal protective equipment includes uniforms, Gloves, Shoes, and Jackets for the winter season.
- Operational Requirements for Sanitary Workers include a Broom, Shovel, Scrapper, Hand Cart, and De-silting tools.

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Transitioning Toward an Efficient Solid Waste Management System

The flowchart illustrates the progression from conventional to advanced solid waste management systems, highlighting a shift in efficiency and operational capacity. Beginning with basic handcart-based collection and transportation methods, the system evolves through intermediate mixed approaches to advanced high-efficiency collection and disposal practices. This structured transition underscores the importance of integrating improved technologies, such as garbage compactors, mini tippers, and arm roll trucks, coupled with at-source collection initiatives, to achieve sustainable and effective waste management solutions.

B. Manpower Calculation

To calculate the manpower needed for solid waste management by categorizing the staff into sanitary workers, vehicle drivers, supervisors, sanitary inspectors, clerks, and other support staff, the number of each type of staff required for each year based on the equipment and tasks needs to be estimated.

1. Assumptions for Staff Categories:

- **Sanitary Workers:** Handle waste collection, operate hand carts, and assist with containers.
- **Vehicle Drivers:** Drive and operate tractor trolleys, arm roll trucks, container carriers, front blade tractors, front end loaders, and dumper trucks.
- **Supervisors:** Oversee operations; assume 01 supervisor per 50 workers.

- **Sanitary Inspectors:** Monitor sanitary conditions; assume 01 inspector per 100 workers.
- **Clerks:** Handle administrative tasks; assume 01 clerk per 200 workers.
- **Other Staff:** Includes mechanics, cleaners, and support staff; assume 01 per 50 workers.

The estimated proposed staff/manpower is given below:

Year		Sanitary workers	Vehicle Drivers	Supervisors	Sanitary Inspectors	Clerks	Other Staff
2023	**Available**	172	05	00	00	01	00
	Gap	40	07	07	02	01	03
2028		227	28	09	04	02	06
2033		276	45	11	06	03	09
2038		335	68	13	08	04	12
2043		408	106	16	10	05	15

C. Planning and Management for Fleet

Collection, operation and maintenance should be observed and monitored by:

a. Planning collection routes
b. O & M of collection vehicles (preventive maintenance)
c. Management of the workforce
d. Communication
e. Monitoring (IT based monitoring system)

1. Planning Collection Routes

Planned and designed carefully to cover all areas including:

- Planned in respect to least distance and minimum fleet
- Take into account traffic conditions
- Take care of any local legislations for example, weight limits on roads or bridges
- Avoid turns across traffic (difficult U turns will and should be avoided)
- The designation for collection routes for vehicles requires an intelligent common-sense approach rather than high technology
- Study the operation

2. Operation and maintenance (O & M) of vehicles

- Vehicle washing before and transfer of waste
- Fully gauged with safety equipment and limitations system (e.g., signals, alarm, light, cautions etc.)

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- Enabled vehicle monitoring system
- Comprehensive and accurate data collection and good planning
- Computer programs for planning vehicles routes
- Knowledge and awareness
- Modern mode of communication and smart planning

3. Management of the workforce

- Planning
- Allocation of duties
- Defining tasks
- Timings
- Number of trips
- Task and Finish system

4. Communication

- There are three levels of communication: at the parking yard, at the beginning of the shift and at the end of shift.
- Equipe supervisors and team with a means of communication
- Mobile phone or two-way radio

5. Monitoring

Collection of data: Routine basis, from time to time and representative of the normal situation.

Analysis: Comparison of current performance with previous performance comparison of, comparison of performance in two locations, comparing the performance of loading crew, comparing drivers, anticipating the effects of possible changes in management, estimating the cost of alternative collection system, comparing actual productivities and unit cost with those expected while system designing or at planning stage.

Smart/IT Monitoring System

Vehicle trip counting system covers:

- Real time monitoring of trips & weight, real time monitoring of waste disposed off in dumping through radio frequency-based device, internal protocol camera (IP cameras) and weighbridge, digital database of each trip and monitoring of town zone and UC wise tonnage.

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Live monitoring of SWM fleet

This monitoring system covers:

- Trackers to be installed in all SWM vehicles, all the movements of vehicle are continuously monitored through this system, is case of violation of route /plan or over speeding will be recorded & fined and stooped time report of all SWM vehicles is prepared on daily basis for their performance monitoring.

8.4.7 Intermediate Treatment Options

Once full collection coverage and environmentally sound disposal practices are established, and where financially feasible, institutional-level waste separation and recycling should be prioritized as the next step in improving the waste management sector. Policies that promote waste reuse, recycling, and resource recovery offer significant environmental benefits and should be integral to waste management strategies. Currently, a substantial portion of recycling and resource recovery is carried out by the informal sector. Establishing citywide biogas generation and composting plants, especially in larger cities with economies of scale in mind, can help move waste management systems further up the waste hierarchy. This approach becomes even more viable if regional waste treatment and disposal facilities are adopted at the provincial or regional level.

Large-scale composting and refuse-derived fuel (RDF) facilities have been established in some areas under public-private partnerships (PPP). However, these facilities often operate at reduced capacity or have shut down due to operational challenges. With focused attention and support from local and provincial governments, these facilities can be revived and brought back to full operational capacity.

Siting of waste disposal facilities	Design of waste disposal facilities	Operation and Management
• Policy framework • Guidance criteria for locating disposal facilities	• Survey • Key infrastructure components • Types of design standards	• KPIs for operation • KPIs for management • Outcomes of poor operation and management

A notable example of innovative waste treatment is the development of biogas plants to support urban transit systems. For instance, waste from livestock or other organic sources can be converted into bio-compressed natural gas (bioCNG) to fuel public transportation systems, while also producing valuable by-products such as compost, liquefied carbon dioxide (CO2), and treated water for non-potable uses. Such initiatives demonstrate how integrated waste management can contribute to environmental sustainability, energy generation, and resource recovery.

This gradual approach, combining institutional support, technological solutions, and community engagement, can significantly improve waste management outcomes and contribute to a circular economy.

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Table 8-47, Landfill Requirement Over 2043

Year	Population	Generation		Impact of 4Rs: reduction, reuse, recycling and recovery (20%)	Collection			Disposal		Landfill site requirement in acres
		Per Capita (Kg)	Total (Kgs)		Collection Efficiency %	Total Weight kg (W_T)	Total Volume, m3	Yearly volume m3	Accumulative volume m3	
2023	186169	0.42	78190.86	62552.68	38	23770	47.54	17352.11	17352.11	0.43
2028	226503	0.45	101926.21	81540.97	54	55040	110.08	40179.31	181312.69	4.47
2033	275575	0.47	129520.32	103616.26	69	89369	178.74	65239.39	455519.67	11.24
2038	335279	0.49	164286.87	131429.49	83	136358	272.72	99541.41	884389.29	21.83
2043	407919	0.52	212117.65	169694.12	100	212118	424.24	154845.88	1546908.59	38.18

Assumptions

- Looe waste density assumed to be 300 kg/m³ and compacted waste assume to be 600 kg/m³
- Landfill Depth: Set at 10 feet (approximately 3 meters).
- Area Conversion Factor: Converts volume to acres: 1 acre=4046.86 m²
- 4Rs Impact: Assumes a 20% reduction in waste through recycling, reuse, and recovery.
- Collection Efficiency: Gradually improves from existing to future.

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8.4.8 Disposal and Landfill Requirements

Effective disposal and landfill management are essential components of a sustainable solid waste management system. In Ghotki City, the increasing volume of waste, projected to reach 185 tons per day by 2043, necessitates the establishment of well-designed and environmentally compliant landfill facilities. Current disposal practices, which rely on open dumping sites located within city limits, pose significant health hazards, environmental degradation, and community distress. This section outlines the strategic measures required to address these challenges, including waste reduction through the 4Rs (Reduce, Reuse, Recycle, and Recovery), improved waste collection efficiency, and the development of engineered landfill sites. By transitioning to modern landfill practices, Ghotki City can mitigate environmental risks and enhance the overall quality of life for its residents.

A. Proposed Solid Waste Landfill Site – Ghotki City

1. Site Location:

The proposed landfill site for Ghotki City is located at **27° 57'1.62"N, 69° 17'11.37"E,** as indicated on the map below (Figure 2-2). The site lies on the outskirts of the city, south of the main urban settlement, with access from nearby secondary roads, facilitating collection and transportation of municipal solid waste. The proposed location has been identified after careful consideration of environmental, social, technical, and regulatory factors to ensure safe and efficient waste disposal up to the year 2043.

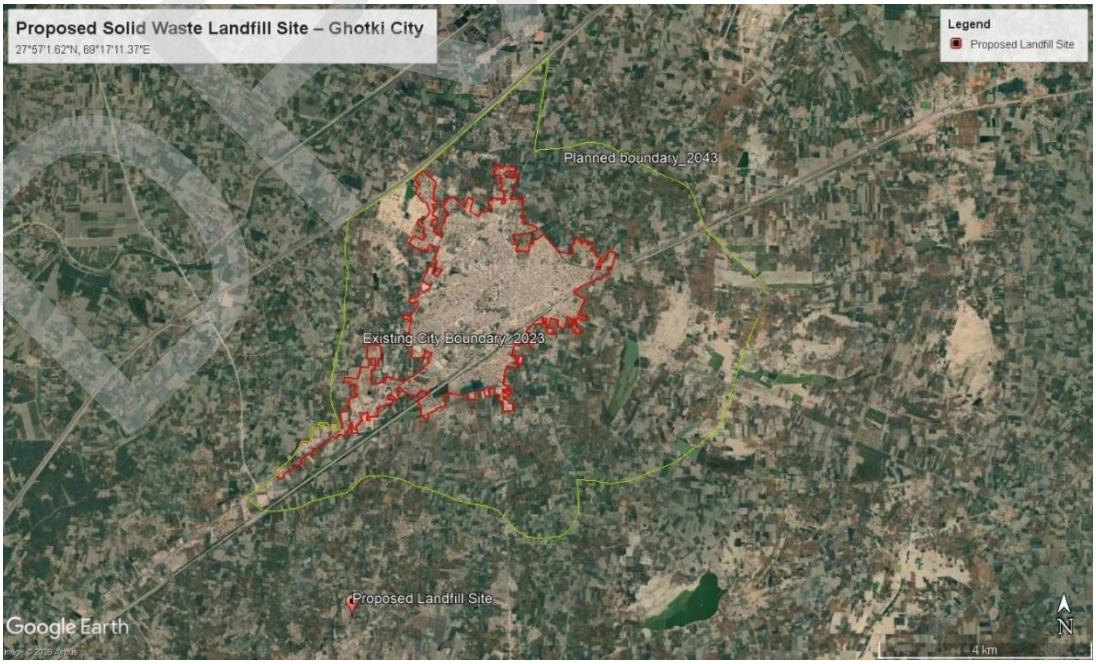


Figure 8-21, Proposed Solid Waste Landfill Site – Ghotki City

The image shows the city boundary in red, planned boundary of 2043 in

green and the proposed landfill site marked with a red pin. Surrounding areas consist of agricultural land and minor settlements, while the site is sufficiently distanced from major water bodies and sensitive receptors. The overall site criteria is given below:

Criteria	Requirement / Standard	Site Assessment (27°57'1.62"N, 69°17'11.37"E)	Remarks / Notes
Distance from water bodies	≥250–500 m	~1–2 km from nearest canal/river	Acceptable; buffer sufficient
Groundwater depth	Preferably >2–3 m	Likely 3–5 m	Moderate; groundwater monitoring recommended
Soil type / permeability	Low permeability (clay preferred)	Predominantly alluvial sandy-loam	Engineered liner required
Flood risk / floodplain	Avoid flood-prone areas	Slightly elevated terrain	Acceptable; minor grading may be needed
Distance from settlements	≥500–1000 m	~1–2 km from nearest village	Acceptable; buffer adequate for odors/noise
Distance from sensitive sites	Schools, hospitals, public areas	≥1 km	Acceptable
Proximity to roads / access	Good road access	Near secondary road network	Good; minor upgrades may be needed
Topography / slope	2–5% gentle slope	Gently sloping land	Ideal for drainage
Land use / protected areas	Avoid agricultural/protected land	Adjacent minor cultivation	Minor conflict; compensation may be needed
Land area available	≥38.18 acres	TBD – current site may need expansion	Ensure total area meets projected waste till 2043
Availability of cover material	Soil or alternative daily cover	Local clay/sandy soil available	Sufficient
Slope stability	Stable, no landslide risk	Flat to gently sloping	Acceptable

The proposed site at 27° 57'1.62"N, 69° 17'11.37"E meets the essential criteria for solid waste landfill siting, including environmental safety, social acceptability, technical feasibility, and regulatory compliance. With proper engineering design, phased development, and operational planning, this site is suitable to serve the city's solid waste management needs until 2043.

B. Key Safeguards Issues

Scope: Landfill leachate management, air pollution from any future waste-to-energy (WtE) facility, and safeguards for informal waste pickers.

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Impact	Mitigation
Liquid leaking from waste entering soil or underground water and creating bad smells.	Keep the base liner and collection system in good condition, pump and treat the liquid, and apply daily soil cover on waste.
Bad smells affecting nearby people.	Reduce the open working face, apply daily soil cover, collect and treat gas, and manage odorous loads quickly.
Pests and birds spreading disease or litter.	Cover waste daily, use bird control measures, keep fencing secure, and maintain site cleanliness.
Wind-blown litter leaving the site.	Install high litter fences near the working area, increase clean-up rounds, and ensure trucks and containers are covered.
Underground gas build-up increasing fire or explosion risk.	Install and maintain gas wells and pipes, monitor gas levels, and keep fire breaks and firefighting equipment ready.
Storm water mixing with waste and becoming dirty water.	Keep clean storm water separate with drains and berms, repair damaged drains, and keep the working face small.
Truck accidents and unsafe movement inside the site.	Use one-way traffic where possible, set clear signs and speed limits, use trained spotters, and require reflective clothing.
Unsafe handling of ash and air cleaning residues causing health and environmental risks.	Cool, separate, and store residues in closed containers, test the material, and send to approved disposal or reuse routes.
Smoke and gases from energy recovery plant stacks worsening outdoor air.	Run the air cleaning system at all times, maintain it well, and keep continuous emission monitors working and calibrated.
Fine dust and harmful compounds escaping during operations.	Use effective filters, schedule regular testing, fix defects immediately, and keep doors and hatches closed.
High noise from machinery, turbines, fans, and trucks disturbing neighbors and workers.	Use acoustic insulation and barriers, maintain equipment, and schedule loud activities during daytime.
High use of water reducing local availability.	Install water-saving devices, fix leaks quickly, collect rainwater from roofs, and reuse treated water for cleaning and landscaping.
High energy use increasing air pollution and costs.	Use energy-efficient motors and lighting, recover heat where possible, and track energy use monthly to drive reductions.
Injuries and poor health of workers and waste pickers.	Provide protective clothing and equipment, vaccinations, safe work training, and clean washing areas.
Unhygienic conditions and spread of disease at sorting or composting areas.	Keep floors clean, provide covered storage, control pests, and separate medical waste and sharp items.

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Impact	Mitigation
Complaints from neighbors about smells, dust, or traffic.	Keep a public complaint phone or desk, log all cases, respond within thirty days, and share actions taken with the community.
Risks to nearby schools, clinics, and homes from site operations.	Place clear signs and boundaries, manage traffic, limit night work near sensitive places, and hold regular community meetings.
Security risks and unauthorized entry to the site.	Install secure fencing, lighting, and trained guards; keep visitor sign-in records and conduct patrols.
Fires, explosions, or major spills causing injuries and environmental harm.	Keep an emergency plan, conduct regular drills, maintain firefighting equipment, store chemicals safely, and report incidents promptly.

8.4.9 Strengthening Estimates of Annual GHG Emissions from the Solid Waste Sector

The Intergovernmental Panel on Climate Change (IPCC) guidelines classify greenhouse gas (GHG) emissions from the solid waste sector into distinct categories, each requiring specific data inputs to develop emission estimates using the Tier 1 methodology:

A. Solid Waste Disposal (IPCC Code 4A)

1. Required Data

- Annual amount of municipal solid waste (MSW) disposed of in managed anaerobic or semi-aerobic landfills, as well as unmanaged deep or shallow landfill sites.
- Waste composition.
- Amount of scavenging at landfill sites, focusing on the remaining waste and its composition.
- Separate GHG emission estimates for urban and rural areas (current estimates focus only on urban areas).

B. Biological Treatment of Solid Waste (IPCC Code 4B)

2. Relevance

- This category is a relatively small source of GHG emissions in Pakistan. Only a few pilot projects for organic waste recycling are operational.

C. Incineration and Open Burning of Waste (IPCC Code 4C)

3. Required Data

- Annual quantity of waste burned openly and its composition.
- Emission estimates from open burning, which is not currently included in Pakistan's inventories.
- Note: Municipal solid waste (MSW) incineration is not practiced in Pakistan.

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D. Current Challenges and Improvements

Pakistan's waste sector GHG estimates are part of its National Communications and Nationally Determined Contribution (NDC). However, uncertainties in activity data affect the accuracy of these estimates. To enhance accuracy:

- Establish data flows using data supply agreements (DSAs) or memorandums of understanding (MOUs) between waste management companies (WMCs), local government departments, and the Ministry of Climate Change (MOCC).
- Ensure timely provision of high-quality data to support sustainable waste management initiatives.

E. Developing GHG Emission Projection

Accurate historical GHG emission estimates will enable improved projections. Waste sector projections should consider the following aspects:

1. **Future Waste Generation Trends:** Projected changes in the quantity and type of waste generated nationally.
2. **Evolving Waste Treatment and Disposal Systems:** Anticipate shifts in the utilization of treatment, disposal, and recycling systems over time.
3. **Technological Advances and Retrofits:** Potential changes in waste parameters and emission factors due to advancements in waste treatment technologies or the adoption of abatement systems.
4. **Optimization of Waste Collection:** Efforts by WMCs and municipalities to reduce fuel consumption through optimized collection systems.

F. Mitigation and Co-Dependencies in Waste Management

Mitigation measures can impact waste generation, treatment, and disposal in various ways, highlighting the need to understand interdependencies across treatment pathways. Projections should consider:

- The mass flow of waste through different stages of the treatment process.
- How mitigation actions, such as waste separation, recycling, or energy recovery, might influence emissions in one or more areas.

G. Energy Recovery from Waste

If energy generation from waste is implemented, emissions resulting from this process must be accounted for in the energy sector to avoid double-counting.

By addressing these factors, Pakistan can develop more robust and precise GHG emission projections, laying the foundation for more effective mitigation strategies within the solid waste sector.

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8.4.10 Financial Planning and Cost Estimates

This section presents indicative financial estimates for the key solid waste management infrastructure and systems proposed under the Strategic Development Plan. The costing covers essential equipment and machinery, landfill development requirements, workshops and training provisions, and selected advanced facilities, providing a high-level financial basis to support planning, prioritization and phased implementation at the city level.

A. Equipment and Machinery

Sr. No.	Equipment / Machinery	Additional Units (2023–2043)	Unit Cost (PKR million)	Total Cost (PKR million)
1	Hand Carts (0.25 m³)	159	0.04	6.36
2	Mini Tipper (≈1 m³)	85	2.50	212.50
3	Containers (0.8 m³)	135	0.07	9.45
4	Mobile Compactor (8 m³)	21	18.00	378.00
5	Front Blade Tractor	6	4.00	24.00
6	Tractor Trolley	94	4.50	423.00
7	Arm-Roll Truck (5 m³)	3	12.00	36.00
8	Front-End Loader	6	18.00	108.00
9	Water Bowser	8	6.00	48.00
—	Subtotal – Equipment & Machinery	—	—	1,245.31

B. Landfill Requirement Over 2043

Item	Value
Total Landfill Area (to 2043)	38.18 Acres
Unit Development Cost (Engineering Only)	PKR 30 million / Acre
Total Development Cost (Excl. Land Cost)	≈ PKR 1,145.40 million
Unit Land Cost (Sindh Rate)	~PKR 4.5 million / Acre*
Total Land Cost (38.18 Acres)	≈ PKR 171.81 million
Total Project Cost (Incl. Land Cost)	≈ PKR 1,317.21 million

**Land cost is assumed based on average rural/agricultural land valuation rates notified by the Board of Revenue, Government of Sindh (DC Rates), prevailing during FY 2024–25.*

C. Indicative Fuel Cost for Waste Haulage to Landfill (O&M)

Parameter	Value
Waste delivered to landfill (2043)	185 tons/day
Average payload per trip	10 tons/trip
Estimated trips per day	19 trips/day

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Parameter	Value
Average haulage distance (one way)	7 km
Average round-trip distance	14 km
Average fuel efficiency (loaded)	2.5 km/litre
Estimated fuel consumption per day	106 litres/day
Estimated fuel consumption per year	38,700 litres/year
Indicative diesel price	PKR 300 / litre
Estimated annual fuel cost	≈ PKR 11.6 million / year

D. Workshop, Parking Sheds & Training

1. Workshop & Parking Sheds

Sr. No.	Component	Qty	Unit Cost (PKR Million)	Total (PKR million)
1	Central Maintenance Workshop	1	40.00	40.00
2	Parking / Service Sheds	2	20.00	40.00
—	Subtotal	—	—	80.00

2. Training & Capacity Building

Cost Element	Basis	Cost (PKR million)
Training Modules (Ops + HSE + Mechanical + Fleet)	Lump Sum	10.00
PPE / Manuals / Toolkits	Lump Sum	5.00
Certifications / External Trainers	Lump Sum	5.00
Total Training	—	20.00

3. Advanced Facilities

Sr. No.	Facility	Description	Lump-Sum Cost (PKR Million)
1	Material Recovery Facility (MRF)	Sorting line, balers, storage, handling	300.00
2	Composting / AD Facility	Organic processing & composting	150.00
3	Environmental Monitoring + LFG System	Groundwater wells, ambient air, LFG flare/utilization	100.00
—	Subtotal – Advanced Facilities	—	550.00

Note: *This figure is conservative and suitable for master planning stage — will be adjusted during feasibility / PC-I.*

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8.4.11 Priority Projects

The priority projects to improve the collection efficiency of solid waste will focus on following key initiatives:

Priority Section	Code	Project / Initiative
Collection	C1	Procurement of Collection Machinery
	C2	Short-Term Collection Optimization
	C3	Hiring & Training of Crew
	C4	Construction of Parking/Service Sheds
	C5	Source Segregation
	C6	Primary Storage & Street Infrastructure
	C7	Digital Service & Feedback
	C8	Worker PPE & Hygiene
		Community Awareness & Engagement (Collection)
Transfer & Transport	T1	Segregated Transfer Stations
	T2	Fleet Procurement
	T3	Maintenance Workshops
	T4	GPS & Fleet Management
	T5	Route Optimization & Scheduling
	T6	Material Recovery Corners
		Community Awareness & Engagement (T&T)
Disposal & Resource Recovery	D1	Expand Engineered Landfill
	D2	Waste-to-Energy (Rejects Only)
	D3	Advanced Sorting & Recycling Hubs (MRF)
	D4	Composting & Anaerobic Digestion
	D5	Legacy Site Upgrading
	D6	Long-Term Staffing & Training
	D7	Environmental Monitoring Systems
	D8	LFG Utilization & Energy
	D9	Producer Responsibility & Markets
		Community Awareness & Engagement (Disposal/Recovery)

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8.4.12 Immediate Action Plan for Core Urban Area

Phase	Year	Priority Project	Objective	Actions
01	0-2 Years	Procurement of Collection Machinery	Establish a baseline for waste management practices and infrastructure.	Conduct detailed assessments of waste generation, collection efficiency, and existing facilities by gradually increasing tractor trolleys and containers (05 m³) rising from **48 tons to 100 tons**, and hand carts expanding from **722 tons to 1500 tons**. This indicates a significant escalation in waste management requirements over the next **20 years**.
		Short-Term Waste Collection Optimization	Enhance current waste collection practices.	Re-assess and optimize collection routes, schedules, and frequencies based on collected data.
		Hiring of Human Resources	Strengthen the workforce to support waste management initiatives.	Recruit additional staff for waste collection, transportation, and management. The cumulative staffing requirement over the period totals **6,373 positions**, with significant increases in sanitary workers, vehicle drivers, and other roles reflecting growing operational demands
		Construction of Parking Sheds for Machinery	Provide adequate infrastructure for the storage and maintenance of machinery.	Design and construct parking sheds to house and protect waste management vehicles and equipment.
02	2028-2032	Development of Transfer Stations	Facilitate efficient waste transportation and processing.	Identify locations and construct transfer stations to streamline the waste transfer process.
		Procurement of Transportation Vehicles	Improve the efficiency and capacity of waste transportation.	Acquire new, fuel-efficient vehicles tailored to waste transportation needs. Transportation vehicle needs will rise from 2023 to 2043, with arm roll trucks increasing from **10 to 21 tons**, and dumper trucks from **18 to 38 tons**.

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Phase	Year	Priority Project	Objective	Actions
		Construction of Maintenance Workshops	Ensure proper maintenance of waste management machinery and vehicles.	Establish workshops for the routine servicing and repair of waste management equipment.
		Implementation of GPS and Fleet Management Systems capacity building of staff	Enhance monitoring and management of waste collection and transportation fleets.	Install GPS systems on all vehicles, develop a fleet management system, and provide staff training.
03	Upto 5 Years	Expansion of Landfill Capacity	Accommodate increasing volumes of waste and improve disposal efficiency.	Plan, design, and expand existing landfill sites, ensuring compliance with environmental standards. Landfill site needs will grow from **0.43 acres in 2023 to 38.18 acres by 2043**, reflecting rising waste generation and population.
		Development of Waste-to-Energy Facilities	Convert waste into usable energy and reduce landfill dependence.	Research, design, and construct waste-to-energy facilities; integrate with existing waste systems.
		Implementation of Advanced Waste Sorting and Recycling Systems	Increase recycling rates and reduce landfill waste.	Introduce advanced sorting technologies, establish recycling centers, and promote recycling programs.
04	Up to 2043	Construction of Composting Facilities	Promote organic waste recycling and reduce landfill pressure.	Design and build composting facilities; establish organic waste collection programs.
		Upgrading of Hazardous Waste Disposal Facilities	Safely manage and dispose of hazardous waste materials.	Upgrade existing facilities or construct new ones to handle hazardous waste in compliance with regulations.
05	2043 onward	Long-Term Staffing and Training	Ensure a skilled workforce for sustainable waste management.	Implement ongoing recruitment, training, and development programs for waste management staff.

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Phase	Year	Priority Project	Objective	Actions
		Establishment of Environmental Monitoring Systems	Monitor and ensure environmental compliance and performance.	Install monitoring systems for air, water, and soil quality; regularly review and report findings.

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SECTION - 9: INFRASTRUCTURE

9.1 Introduction

The infrastructure section forms the backbone of Khairpur city's sustainable growth, encompassing transportation, telecommunication, power, and gas networks, all of which are vital for economic development and improved quality of life. This section evaluates existing infrastructure gaps, outlines strategic interventions, and proposes actionable solutions to modernize and expand these sectors, ensuring Khairpur's alignment with regional development goals and enhancing its competitiveness as a key urban centre.

9.2 Transportation

A development Masterplan for Roads is a detailed long-term plan that guides how roads will be developed, maintained, and managed to meet the current and future needs of the area. It represents a clear practical vision to ensure the functionality of roads network for every stake holder not merely a list of road projects. It also enables a city to develop a coordinated, institutional framework to make the most of the opportunities with a sustainable development approach.

Roads are the lifeline of any region, similarly, people depend heavily on road transport for daily commuting, business, and social activities in Pakistan. Roads connect cities, towns, and villages, helping people reach schools, hospitals, markets, workplaces and transporting good, which is a basic need for any community to grow socially and economically.

Without proper planning, roads can become overcrowded, unsafe, and expensive to maintain. Many areas face problems like traffic jams, frequent accidents, and roads that get damaged quickly during the monsoon season. A development masterplan strategically addresses these issues by looking at the whole road network and planning for growth, safety, and durability.

The masterplan usually looks ahead 10 to 20 years or more, taking into account population growth, urban expansion, increasing vehicle numbers, and changes in travel patterns. It also considers how roads fit into the environment and the lives of all users, including pedestrians, cyclists, and public transport.

This report will be the continuation of the previous reports which were highlighting the baselines of the city. All the primary and secondary data which was collected from the city in the form of different surveys and consultations was presented in the Situation Analysis Report (SAR), on the basis of which a SWOT analysis was performed. In this report we will be focusing on analysing the collected data to utilize it in forming a well-formed

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and practical masterplan. An immediate action plan (0-2 years), a short-term plan for next 05 years and long-term plan for next 20 years of the city shall be discussed in this report. A priority criterion will be set in this report and existing road infrastructure will be evaluated through the set criteria, and the roads that need rehabilitation the most will be highlighted respectively.

A) Conceptual Framework of the Development Masterplan

The masterplan acts as a roadmap that helps authorities and planners make the calculated and timely decisions about certain roads. It lays down a clear vision for how the road network should develop over time and sets priorities for where to construct new roads, which roads need upgradation and how to maintain them properly.

It integrates technical, social, and economic factors to ensure the network is efficient, safe, and sustainable. This includes considering different types of roads such as national highways, provincial roads, urban streets, and rural access roads. Each has a specific role but all need to work together smoothly.

The plan also aligns road development with other important aspects of regional planning such as housing, industry, and environmental protection. This coordination avoids problems like roads cutting through sensitive areas or new developments creating traffic bottlenecks.

B) Uses of a Development Masterplan for Roads

The Development Masterplan for Roads is a practical tool used by government departments, planners, engineers, and other stakeholders to manage road infrastructure in a balanced and sustainable way. The main uses include:

1. Prioritizing Road Construction and Upgrades

One of the most important uses of the masterplan is to help decide where new roads should be built or existing roads need to be widened or upgraded. This decision is based on understanding current traffic patterns, population trends, economic activities, and future growth areas.

For example, if a certain highway is heavily congested during peak hours, the masterplan may recommend widening it or constructing an alternative bypass. Similarly, if a rural area is developing quickly due to agriculture or industry, new access roads might be planned to connect farms or factories to main highways.

By prioritizing these projects, the plan ensures that money and resources are used where they can have the biggest positive impact. This avoids random or unplanned road works that do not solve real problems or that cause new issues.

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2. Guiding Maintenance and Asset Management

Roads are expensive to build, but they also need regular care to stay in good condition. The masterplan helps by providing a schedule and framework for maintaining roads based on their condition and importance.

This means identifying which roads need urgent repairs like pothole filling or resurfacing, and which require long-term rehabilitation. It also helps plan routine activities like cleaning drainage channels, fixing road signs, and maintaining road markings, all of which contribute to safer and smoother travel.

Good maintenance planning helps prevent costly repairs later and reduces accidents caused by poor road conditions. It also ensures that limited budgets are used efficiently, focusing on roads that serve the most people or carry the heaviest traffic.

3. Managing Traffic Flow and Improving Safety

Traffic congestion and road accidents are major challenges in many parts of Pakistan. The masterplan helps address these by recommending solutions based on careful study of traffic patterns in the study area.

Safety is also a key focus. The masterplan includes proposals for better road signs, speed control measures, pedestrian crossings, and improved street lighting. These steps reduce accidents and make roads safer for drivers, pedestrians, cyclists, and motorcyclists.

Additionally, the plan encourages providing safe access to schools, hospitals, and markets, ensuring that vulnerable road users such as children and elderly people are protected.

4. Supporting Economic Growth and Social Development

Well-planned roads boost the economy by improving the movement of goods and people. The masterplan helps identify routes that connect important economic centres such as industrial zones, ports, agricultural markets, and urban business areas. Improved road access reduces travel time and transportation costs, helping businesses operate more efficiently and encouraging investment in the region. This, in turn, creates jobs and improves living standards.

On the social side, the masterplan promotes equitable access to roads for all communities, including remote rural areas. This helps connect people to education, healthcare, and other social services, reducing isolation and promoting balanced regional development.

9.2.1 Methodology and Scope

This section outlines the approach and boundaries of the study carried out for the Development Masterplan of road infrastructure in the core urban area of Khairpur, Sindh. It covers the approach taken to collect information, analyse data.

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A. Objectives of the Study

The study aims to:

- Understand the current condition of roads in Khairpur's urban area.
- Identify which roads need repair or improvement most urgently.
- Suggest a plan for building new roads and expanding the network in future.
- Support better traffic flow and safer travel in the city.

B. Methodology Overview

To ensure clear understanding of the existing road network and to help identify practical steps for improvement a systematic approach was established. The process cantered on gathering reliable information, analysing it carefully, and involving key stakeholders to make sure the results truly reflect the situation on the ground in Khairpur.

The study combined both quantitative data (like traffic volumes, road conditions, and network coverage) and qualitative inputs (such as Household surveys). This combination helps create a balanced picture of the road network's strengths and weaknesses.

1. Data Collection Methods

To get a good picture of the roads, the team used different ways to collect information:

- Socio Economic Survey
- Manual Classified Counts (MCCs)
- Roadside Interviews (RSI)
- Journey Time Surveys (JTS)
- Inventory and Condition Survey (IandCS)
- Pictorial Survey

2. Assessment Criteria

To decide the roads that need immediate attention, and how future projects will be listed, following criteria has been used in listed order:

- Conditions of the existing roads
- Volume/Capacity ratio of the existing roads
- Importance of roads within the city based on adjacent land use

3. Tools and Techniques Used

- Situation Analysis
- Digital Base Maps
- SWOT Analysis
- Prioritization System
- Making sure road plans fit with other services like water and drainage.

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First 3 steps have already been covered and respective reports have been submitted. This report is in continuation to these studies and development of prioritization criteria in liaison with other departments ongoing city development plans to make sure all efforts work together smoothly.

C. Scope of the Study

This study focuses only on roads of Khairpur city. It covers all types of roads from bypass to collectors to streets.

9.2.2 Baseline Analysis and Prioritization of Road Network

This section presents the baseline analysis of the road network in Khairpur's urban area and outlines the process used to prioritize roads for rehabilitation and future development. The chapter begins by reviewing relevant information from earlier reports prepared for the project. It then describes the surveys conducted to collect the information of the existing roads, followed by an assessment of their condition. Finally, it explains how priority roads were identified based on clear criteria, and suggests future road development plans to support the city's growth.

A. Previous Submissions

1. Inception Report

The Inception Report defined the initial scope, methodology, and engagement strategy for the preparation of the development master plans for Khairpur and other cities under Package-I. It set the tone for systematic data collection, GIS mapping, and stakeholder inclusion, ensuring that the plan would be grounded in both empirical evidence and community inputs.

2. Situation Analysis Report (SAR)

The SAR provided a detailed assessment of Khairpur's current situation. It revealed that Khairpur has a connected road and rail network but faces issues with poor infrastructure, traffic management, and urban planning. Many roads are in fair to poor condition, public transport is dominated by low-quality informal modes, and walking is the most common due to the city's compact size. The lack of structured parking, unplanned intersections, and absence of ongoing projects highlight the need for strategic improvements.

3. Digital Base Map and Explanatory Report

The Digital Base Map produced high-resolution spatial data visualizing land use patterns, infrastructure, and environmental assets. It highlighted high-density corridors, urban sprawl directions, and critical infrastructure bottlenecks. This provided the spatial basis for future planning decisions and zoning reforms.

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4. SWOT Analysis

Through participatory workshops, the SWOT analysis highlighted strengths of Khairpur like a strategic location and agricultural productivity, while addressing weaknesses such as poor planning and inadequate services. Opportunities include leveraging the China-Pakistan Economic Corridor and promoting agro-industries, whereas threats involve climate change and unplanned growth. A future vision—developed through stakeholder input—aims to make Khairpur a "Safe and Smart City" through inclusive growth, sustainable development, and environmental resilience, aligned with national and global strategies.

B. Surveys Conducted

Identification of the existing road network is a foundational step in transportation planning. A clear and comprehensive understanding of the current network is essential for effective planning, forecasting, and decision-making. Due to a limitation of secondary data from the MC, the consultant has conducted multiple surveys e.g. Inventory, condition, and Pictorial survey etc. to identify the gaps in the existing road network. Surveys like traffic surveys, roadside interviews, etc have already been discussed in Situation Analysis Report previously.

1. Inventory and Condition Survey

Inventory and Condition Survey (IandCS) was conducted in the month of September in 2023. The Proformas for IandCS were submitted to the Client along with the Inception report. The data collected from the proformas encompassed all details related to road cross-sections, including the carriageway, shoulder, walkway, roadside drain, services corridor, road furniture, land use type, and encroachment.

Inventory and Condition survey was carried out on almost all links/roads having ROW more than 18-20' within the MC boundaries despite of their pavement type. **Table** 9-1 shows the IandCS results recorded from the study area. This list will be rearranged according to the set prioritisation criteria which will be defined in the next section of this chapter.

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Table 9-1, Land CS results

Sr No.	Road Name	Start	End	Length (Km)				Walkway			Roadside Drain			Road Furniture					Land Use Type
					Total Metalled Width (ft)	Pavement Type	Pavement Condition	Width (ft)	Condition	Available (One / Both Sides)	Width (ft)	Condition	Type	Width (ft)	Condition	Pavement Markings	Road Signs	Street Light Pole	Electric Pole	Telephone Pole	Urban/ Rural
KHP-01	National Highway	0	0.8	13.13	28	Asphalt	Fair	5	Fair	-	-	-	Brick / Covered	3	Fair	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.8	2.8		35	Asphalt	Fair	-	-	-	-	-	Brick / Covered	3	Fair	Not Exists	Not Exists	Exists	Not Exists	Exists	Commercial
		2.8	6.4		48	Asphalt	Good	5	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Commercial
		6.4	7.2		35	Asphalt	Good	-	-	-	-	-	-	-	-	Not Exists	Exists	Exists	Exists	Not Exists	-
		7.2	8.1		52	Asphalt	Good	-	-	2	6	Fair	Brick / Covered	4	Fair	Not Exists	Exists	Exists	Exists	Not Exists	Commercial
		8.1	9.7		55	Asphalt	Good	-	-	2	4	Fair	Brick / Covered	4	Fair	Not Exists	Exists	Exists	Exists	Exists	Commercial
		9.7	10.4		60	Asphalt	Good	-	-	2	4	Fair	Brick / Covered	4	Fair	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		10.4	11.4		34	Asphalt	Bad	5	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	Commercial
		11.4	13.13		24	Asphalt	Bad	5	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	Mixuse
KHP-02	Radio Station Road	0	1.2	2.7	35	Asphalt	Good	5	Fair	-	-	-	-	-	-	Exists	Not Exists	Exists	Not Exists	Not Exists	Rural
		1.2	2.7		25	Asphalt	Good	5	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	Commercial
KHP-03	Mirwah Canal Road-01	0	1.3	1.8	18	Asphalt	Good	5	Fair	-	-	-	Brick / Open	2	Bad	Exists	Not Exists	Exists	Exists	Not Exists	Mixuse
		1.3	1.8		20	Asphalt	Good	5	Fair	-	-	-	Brick / Open	2	Bad	Exists	Not Exists	Exists	Exists	Not Exists	Mixuse
KHP-04	Khairpur Road	0	1	1.7	48	Asphalt	Good	5	Bad	-	-	-	-	-	-	Exists	Not Exists	Exists	Not Exists	Not Exists	-
		1	1.7		24	Asphalt	Fair	-	-	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Not Exists	Not Exists	-
KHP-05	Pirjo Goth Road	0	0.7	38.9	32	Asphalt	Bad	-	-	2	3	Poor	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.7	1.2		38	Asphalt	Poor	-	-	-	-	-	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		1.2	2.6		55	Asphalt	Good	-	-	-	-	-	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		2.6	2.7		32	Asphalt	Good	-	-	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		2.7	38.9		16	Asphalt	Fair	5	Fair	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Rural
KHP-06	Old Bridge Pirjo Goth Road	0	0.7	0.7	20	Asphalt	Poor	3	Bad	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	Rural
KHP-07	Station Road	0	0.3	-	68	Asphalt	Good	-	-	2	4	Fair	Brick / Covered	3	Fair	Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.3	-		12	Asphalt	Poor	3	Poor	-	-	-	-	-	-	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Rural
KHP-08	Canal Road (Hajana Muhallah)	0	0.4	18.2	20	Earthen	Bad	3	Bad	-	-	-	-	-	-	Not Exists	Not Exists	Not Exists	Not Exists	Not Exists	Residential
KHP-09	MUET Road	0	0.8		35	Asphalt	Good	4	Fair	-	-	-	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	Commercial
		0.8	1.5		40	Asphalt	Bad	-	-	2	5	Poor	5	4	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	Commercial
		1.5	1.7		33	Asphalt	Bad	-	-	2	5	Poor	5	4	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	Commercial
		1.7	2.1		28	Asphalt	Good	-	-	1	5	Poor	5	4	Bad	Exists	Not Exists	Exists	Exists	Not Exists	-
		2.1	17		27	Asphalt	Good	-	-	2	4	Good	Brick / Covered	4	Good	Not Exists	Not Exists	Not Exists	Exists	Not Exists	-
		17	17.1		30	Asphalt	Good	-	-	2	4	Good	Brick / Covered	4	Good	Not Exists	Not Exists	Not Exists	Exists	Not Exists	-
		17.1	17.6		44	Asphalt	Good	-	-	2	4	Good	Brick / Covered	4	Good	Not Exists	Not Exists	Not Exists	Exists	Not Exists	-

Sr No.	Road Name	Start	End	Length (Km)	Total Metalled Width (ft)	Pavement Type	Pavement Condition	Walkway					Roadside Drain			Road Furniture					Land Use Type
								Width (ft)	Condition	Available (One / Both Sides)	Width (ft)	Condition	Type	Width (ft)	Condition	Pavement Markings	Road Signs	Street Light Pole	Electric Pole	Telephone Pole	Urban/ Rural
		17.6	18.2		30	Asphalt	Good	-	-	2	4	Good	Brick / Covered	4	Bad	Not Exists	Not Exists	Not Exists	Exists	Not Exists	-
KHP-10	Talpur Colony Road	0	0.2	2.5	25	Asphalt	Good	-	-	1	3	Bad	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.2	0.7		50	Asphalt	Good	-	-	2	3	Bad	Brick / Covered	3	Bad	Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.7	1.5		50	Asphalt	Good	-	-	2	3	Bad	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		1.5	2		30	Asphalt	Good	-	-	2	4	Bad	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		2	2.1		35	Asphalt	Fair	-	-	2	4	Bad	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		2.1	2.5		35	Asphalt	Fair	-	-	2	4	Bad	-	-	-	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
KHP-11	Station Road (Neem Mor)	0	0.6	0.6	24	Asphalt	Good	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Residential
KHP-12	Chandio Mor Road	0	0.3	0.8	28	Paver	Good	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.3	0.7		34	Paver	Good	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	Commercial
		0.7	0.8		52	Paver	Good	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	Commercial
KHP-13	Civil Hospital Road	0	0.3	2.1	62	Asphalt	Good	-	-	2	3	Fair	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.3	0.7		45	Asphalt	Good	-	-	2	3	Poor	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.7	0.9		52	Asphalt	Good	-	-	2	3	Poor	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.9	1.4		25	Asphalt	Bad	-	-	1	3	Poor	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	Commercial
		1.4	1.9		25	Asphalt	Good	-	-	1	3	Poor	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	Agricultural
		1.9	2.1		50	Asphalt	Good	4	Fair	1	3	Poor	Brick / Covered	3	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	Mixuse
KHP-14	Sohu Kanaserah Road	0	0.8	5.4	40	Asphalt	Poor	-	-	1	8	Fair	Brick / Covered	8	Fair	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.8	1.7		30	Asphalt	Poor	-	-	-	-	-	-			Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		1.7	2.1		16	Asphalt	Poor	-	-	-	-	-	-			Not Exists	Not Exists	Exists	Exists	Not Exists	Rural
		2.1	5.4		18	Asphalt	Good	-	-	-	-	-	-			Exists	Not Exists	Not Exists	Exists	Not Exists	Rural
KHP-15	Mill Colony Road	0	0.6	0.9	25	Asphalt	Fair	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Not Exists	Exists	Exists	R
		0.6	0.9		35	Asphalt	Poor	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Not Exists	Exists	Exists	R
KHP-16	Pro.Hami Colony Road (KMC Hostel)	0	0.1	1.1	26	Asphalt	Good	-	-	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Residential
		0.1	0.4		28	Paver	Good	-	-	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Not Exists	Exists	Exists	Residential
		0.4	0.9		12	Asphalt	Poor	3	Poor	-	-	-	Brick / Open	3	Poor	Not Exists	Not Exists	Not Exists	Exists	Not Exists	R
		0.9	1.1		12	Paver	Fair	-	-	-	-	-	Brick / Open	3	Poor	Not Exists	Not Exists	Not Exists	Exists	Not Exists	R
KHP-17	Canal Road	0	1	1	11	Asphalt	Bad	3	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Residential
KHP-18	Mirwah Canal Road-01 (Highway-Phattak)	0	0.3	2.6	18	Asphalt	Fair	3	Fair	1	8	Good	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	-
		0.3	0.6		20	Asphalt	Fair	-	-	1	9	Good	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	-
		0.6	1.5		22	Asphalt	Fair	-	-	1	4	Good	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	-
		1.5	2.6		24	Asphalt	Fair	-	-	1	3	Good	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	-

Sr No.	Road Name	Start	End	Length (Km)				Walkway			Roadside Drain			Road Furniture					Land Use Type
					Total Metalled Width (ft)	Pavement Type	Pavement Condition	Width (ft)	Condition	Available (One / Both Sides)	Width (ft)	Condition	Type	Width (ft)	Condition	Pavement Markings	Road Signs	Street Light Pole	Electric Pole	Telephone Pole	Urban/ Rural
KHP-19	Forest Department Road	0	1	1	20	Asphalt	Fair	5	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Residential
KHP-20	WAPDA Colony Road	0	0.5	2.3	14	Asphalt	Bad	5	Fair	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Residential
		0.5	1.6		14	Asphalt	Bad	5	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Rural
		1.6	2.3		14	Asphalt	Fair	5	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Exists	Exists	Rural
KHP-21	One Unit Road	0	0.2	0.2	44	Asphalt	Good	4	Fair	1	5	Good	-	-	-	Not Exists	Not Exists	Exists	Exists	Exists	Rural
KHP-22	Bilawal Park Road	0	0.4	0.4	18	Asphalt	Good	3	Poor	-	-	-	-	-	-	Not Exists	Not Exists	Not Exists	Not Exists	Not Exists	Rural
KHP-23	Mirwah Canal Road 02	0	0.3	2.9	25	Asphalt	Good	-	-	2	3	Fair	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	Mixuse
		0.3	1.4		40	Asphalt	Good	-	-	2	3	Fair	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	Mixuse
		1.4	2		36	Asphalt	Bad	-	-	1	8	Fair	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	Mixuse
		2	2.9		36	Asphalt	Bad	-	-	2	4	Fair	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	Mixuse
		2.9	3.8		13	Asphalt	Good	-	-	-	-	-	-	-	-	Not Exists	Not Exists	Not Exists	Not Exists	Not Exists	Rural
KHP-24	Mirwah Colony Road	0	0.1	0.4	12	Paver	Fair	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Residential
		0.1	0.3		11	Paver	Fair	-	-	-	-	-	Brick / Open	1.5	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Residential
		0.3	0.4		13	Paver	Fair	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Residential
KHP-25	Faiz Mahal Road	0	0.3	0.6	12	Asphalt	Good	5	Good	2	7.5	Good	-	-	-	Not Exists	Not Exists	Exists	Exists	Exists	-
		0.3	0.5		12	Asphalt	Good	-	-	1	9	Good	-	-	-	Not Exists	Not Exists	Exists	Exists	Exists	-
		0.5	0.6		9	Asphalt	Good	-	-	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Exists	Exists	Not Exists	-
KHP-26	Mumtaz Ground Road	0	0.2	0.2	35	Asphalt	Good	-	-	2	3	Poor	-	-	-	Not Exists	Not Exists	Exists	Not Exists	Exists	Residential
KHP-27	Staff Quarter Road	0	0.1	0.4	36	Asphalt	Good	-	-	2	12	Good	-	-	-	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.1	0.4		36	Asphalt	Good	-	-	2	5	Good	-	-	-	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
KHP-28	Katchehry-DCO Road	0	0.3	1.5	50	Asphalt	Good	-	-	2	3	Fair	Brick / Open	3	Fair	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.3	0.6		50	Asphalt	Good	-	-	2	3	Fair	Brick / Open	3	Fair	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.6	1		39	Asphalt	Good	-	-	2	7	Fair	Brick / Open	3	Fair	Exists	Not Exists	Exists	Exists	Exists	Commercial
		1	1.5		42	Asphalt	Good	-	-	2	11.5	Fair	Brick / Covered	5	Fair	Exists	Not Exists	Exists	Exists	Exists	-
KHP-29	Imambargah Road	0	0.6	1.1	32	Paver	Good	-	-	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Exists	Exists	Exists	-
		0.6	0.7		40	Paver	Good	-	-	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Exists	Exists	Exists	-
		0.7	0.8		12	Paver	Good	-	-	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Exists	Not Exists	Exists	-
		0.8	1.1		20	Paver	Good	-	-	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Not Exists	Exists	Exists	-
KHP-30	Shahi Bazar Road	0	1.5	1.8	30	Paver	Fair	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	-
		1.5	1.6		14	Paver	Fair	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	-
		1.6	1.7		9	Paver	Bad	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Not Exists	Exists	Exists	-
		1.7	1.8		13	Paver	Good	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Not Exists	Exists	Exists	-

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Sr No.	Road Name	Start	End	Length (Km)				Walkway			Roadside Drain			Road Furniture					Land Use Type
					Total Metalled Width (ft)	Pavement Type	Pavement Condition	Width (ft)	Condition	Available (One / Both Sides)	Width (ft)	Condition	Type	Width (ft)	Condition	Pavement Markings	Road Signs	Street Light Pole	Electric Pole	Telephone Pole	Urban/ Rural
KHP-31	Zahoor Malak Road	0	0.1	0.3	16	Asphalt	Good	-	-	-	-	-	Brick / Open	3	Good	Not Exists	Not Exists	Not Exists	Exists	Exists	-
		0.1	0.2		12	Paver	Fair	-	-	-	-	-	Brick / Open	3	Good	Not Exists	Not Exists	Not Exists	Exists	Exists	-
		0.2	0.3		10	Paver	Fair	-	-	-	-	-	Brick / Open	3	Good	Not Exists	Not Exists	Not Exists	Exists	Exists	-
KHP-32	Panj Gola Road	0	0.2	0.5	31	Paver	Good	-	-	1	3	Bad	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
		0.2	0.5		34	Asphalt	Fair	-	-	1	3	Bad	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Exists	Commercial
KHP-33	Shadishaheed Road	0	0.6	2.4	26	Paver	Good	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	-
		0.6	2.4		18	Asphalt	Good	5	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Not Exists	Not Exists	-
KHP-34	Osta Gahi Road	0	0.9	1.5	18	Asphalt	Fair	5	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	Agricultural
		0.9	1.4		21	Paver	Good	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	Residential
		1.4	1.5		20	Paver	Good	-	-	-	-	-	Brick / Open	3	Bad	Not Exists	Not Exists	Exists	Exists	Not Exists	Mixuse
KHP-35	Jamali Goth Road	0	0.3	1.1	22	Asphalt	Bad	-	-	-	-	-	Brick / Open	2	Poor	Not Exists	Not Exists	Not Exists	Not Exists	Not Exists	Residential
		0.3	1.1		16	Asphalt	Good	5	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Not Exists	Not Exists	Residential
KHP-36	Jail Road	0	0.4	3.4	22	Asphalt	Good	5	Good	-	-	-	Brick / Covered	3	Good	Exists	Not Exists	Exists	Exists	Exists	Mixuse
		0.4	3.4		18	Asphalt	Good	5	Good	-	-	-	-	-	-	Not Exists	Not Exists	Not Exists	Not Exists	Not Exists	Agricultural
KHP-37	N-5	0	0.2	0.7	13	Asphalt	Bad	3	Fair	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Residential
		0.2	0.5		17	Asphalt	Bad	3	Fair	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Residential
		0.5	0.6		21	Paver	Fair	3	Fair	-	-	-	-	-	-	Not Exists	Not Exists	Exists	Exists	Not Exists	Residential
		0.6	0.7		19	Paver	Bad	-	-	-	-	-	Brick / Open	3	Fair	Not Exists	Not Exists	Not Exists	Exists	Not Exists	Residential

Source: *The Consultant Team*

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Khairpur City has mostly two-lane roads with 45% of total roads in the city having an average lane width of approximately 11 feet. The pavement condition is not good, with approximately 52% of roads identified as bad. No road signs, pavement markings, and street lights are provided on the roads.

5. Pictorial Survey

A detailed pictorial survey was also carried out to capture the true picture of the existing condition of the subject study area. The pictorial survey was done parallel with landCS as shown in and all notable conditions were captured with the point of view of recognisance for planning and detail design. Some of the images are attached below in **Figure** 9-1.











Figure 9-1, Pictorial Survey of Khairpur

C) Strategic Development Master Plan

Situation Analysis of the project city necessitated surveys which were carried out based on Traffic operation and present Infrastructure and is explained in detail in the SAR report of the city.

Consequently, inventory, condition, and pictorial survey etc. were carried out to identify the gaps in the existing road network. Strategic development plan was then carved out in a way that the road infrastructure projects are

categorized in 3 classes namely core urban area projects, intermediate projects and future projects, in line with the TORs of the project.

Core urban area projects and intermediate projects have been prioritized based on the criteria mentioned in the next section and on the basis of utility rehabilitation projects e.g., sewer rehabilitation, etc. These projects are listed combinedly in **Table** 9-2 below and are bifurcated in the subsequent Immediate Action Plan and Priority Projects Reports. Similarly, future planned road projects are identified and prioritized based on future master planning aspects and are listed in **Table** 9-3 below.

D) Prioritization Criteria and Priority Roads

Based on the findings from the Situation Analysis Report, SWOT Report and surveys like Inventory and Condition Survey (IandCS), this chapter outlines a phased action plan to improve Khairpur's road network. The plan is divided into immediate, short-term, and long-term actions, depending on the current conditions, usage patterns, and future development needs of the city.

To ensure that road improvements bring maximum benefit, a clear prioritization framework is followed. This helps determine which roads should be upgraded first, whether they are inside the existing urban area or in regions expected to grow. Roads are prioritized not only based on how badly they are deteriorated, but also on how important they are in terms of local land use and traffic movement.

By using this approach, Khairpur can address its most urgent infrastructure needs while also laying the groundwork for better mobility and connectivity in the future. This chapter presents the following specific criteria used for prioritization:

- Improvement of roads within the city based on adjacent land use
- Volume/Capacity ratio of the existing roads
- Conditions of the existing roads
- Identification of new or under-connected areas that require road access or rehabilitation

Based on the above criteria, a priority list (for both immediate and early action plan) of the existing roads has been established in **Table** 9-2 and shown in **Figure** 9-2 and list of proposed future roads (for long term action plan) has been given in **Table** 9-3 and shown in **Figure** 9-3.

Table 9-2, List of Priority Roads

No.	Name of Road	Adjacent Landuse
KHP-P-01	Pirjo Goth Road	Commercial
KHP-P-02	*Jamali Goth Road	Commercial / Residential

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No.	Name of Road	Adjacent Landuse
KHP-P-03	Mill Colony Road	Residential
KHP-P-04	Pro.Hami Colony Road (Kmc Hostel)	Residential
KHP-P-05	Canal Road (Hajana Mohallah)	Agricultural / Residential
KHP-P-06	*Civil Hospital Road	Mixuse
KHP-P-07	*Luqman Colony Road	Residential
KHP-P-08	Old Bridge Pirjo Goth Road	Agricultural / Residential
KHP-P-09	Canal Road	Agricultural / Residential
KHP-P-10	Forest Department Road	Agricultural / Residential

**These roads are to be rehabilitated after replacing sewer line.*

The proposed initiative focuses on the rehabilitation of road infrastructure. The scope may include:

- Reconstruction of roads in poor condition
- Resurfacing and/or structural overlay of roads suffering from surface cracking
- Construction of side shoulders and installation of roadside drainage, if & where needed
- Clearance of encroachments and geometric corrections where feasible
- Provision of footpaths, particularly in high pedestrian traffic zones
- Improvement of road-side infrastructure

All improvements will be aligned with sustainable road engineering practices and coordinated with utility service departments to prevent post-construction disturbances.

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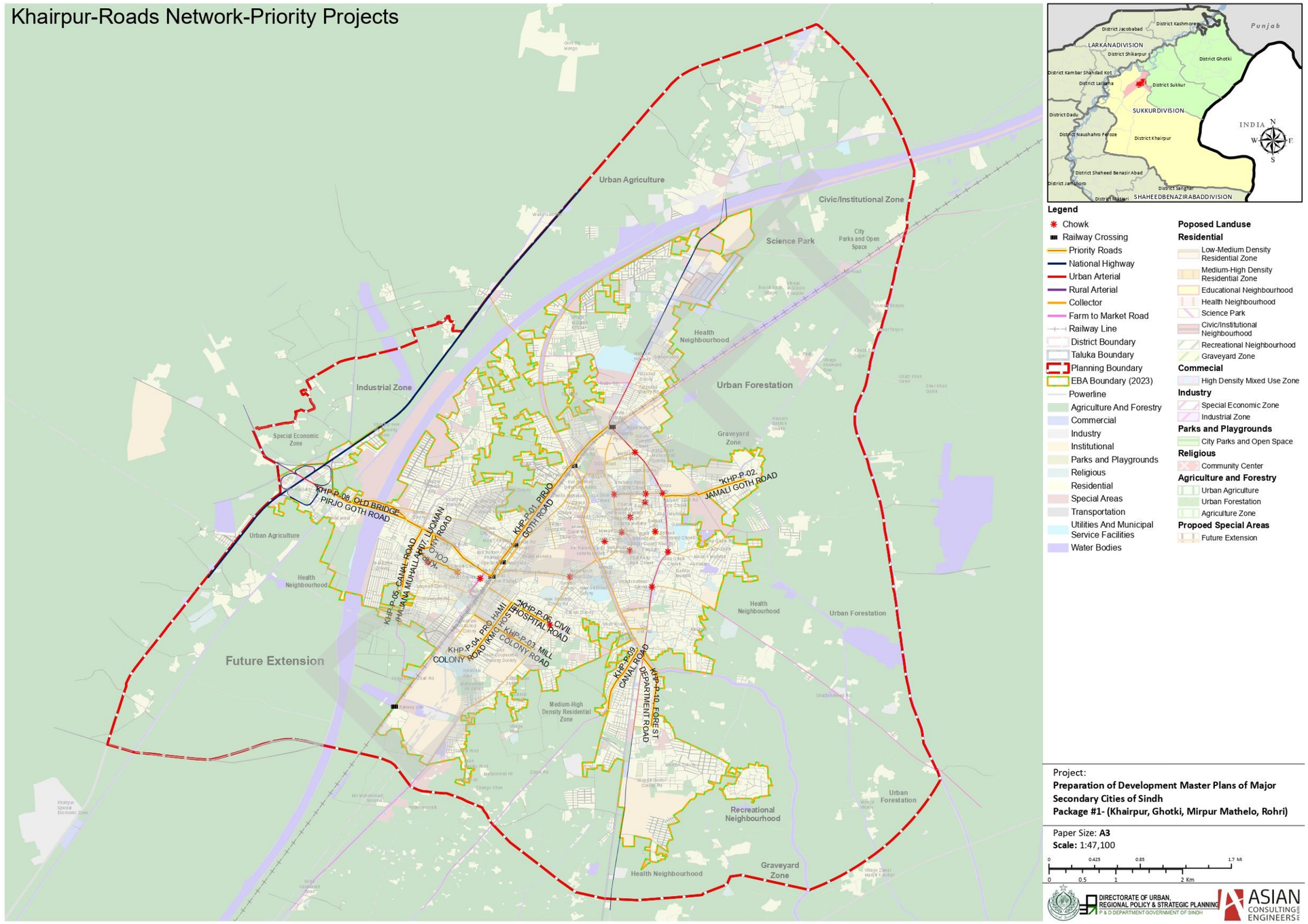


Figure 9-2, Priority Roads Network Map of Khairpur

Source: *The Consultant Team*

2. Priority Roads Project

This section highlights the priority projects for the upgradation and expansion of Khairpur's road network, focusing on improving connectivity, safety, and accessibility to support the city's growing socio-economic needs. Given Khairpur's strategic location within Sindh and its role as a regional hub, enhancing the existing road infrastructure including major provincial highways and new link roads is essential to facilitate efficient transportation of goods and people.

The proposed priority projects aim to upgrade key routes to standard widths with proper drainage and safety features, reduce travel times, and connect rural areas with urban centers, thereby promoting regional development and integration. These improvements will not only address current deficiencies in road quality and capacity but also lay the foundation for sustained economic growth and improved quality of life for residents.

Road Network Upgradation and New Link Road

The road network in Khairpur is facing significant challenges due to continued neglect, inadequate drainage systems, ad hoc utility installations and overloading of heavy vehicles. The deterioration has become a major concern, directly affecting mobility, safety, and the regional economy.

Road segments of collectors and arterials, present in critical locations, including agricultural and industrial zones, have experienced varying degrees of structural failure. Many roads suffer from surface cracking, base erosion, edge breaking, and water-related damage. Additionally, encroachments, poor geometric design, and lack of pedestrian facilities further reduce the functionality and safety of the network.

This situation demands a systematic rehabilitation and improvement program, prioritizing the most critical sections based on condition, traffic load, economic importance, and connectivity value.

List of Priority Projects (Excluding Core Urban Areas)

Sr. No.	Name of Road	Adjacent Landuse	Length (Km)	Tentative Cost (Million PKR)
KHP-P-08	Old Bridge Pirjo Goth Road	Agricultural / Residential	0.75	103.45
KHP-P-09	Canal Road	Agricultural / Residential	1.00	169.59
KHP-P-10	Forest Department Road	Agricultural / Residential	1.07	97.69

Scope of Proposed Work

The proposed initiative focuses on the rehabilitation of road infrastructure. The scope may include:

- Reconstruction of roads in poor condition
- Resurfacing and/or structural overlay of roads suffering from surface cracking
- Construction of side shoulders and installation of roadside drainage, if & where needed
- Clearance of encroachments and geometric corrections where feasible
- Provision of footpaths, particularly in high pedestrian traffic zones
- Improvement of road-side infrastructure

All improvements will be aligned with sustainable road engineering practices and coordinated with utility service departments to prevent post-construction disturbances.

Project Benefits

- Improved Regional Connectivity
- Reduced Transportation Costs
- Increased Road Safety
- Support to Economic Activities

Institutional Responsibility

The implementation of the proposed works will be led by the Works and Services Department, Government of Sindh, in coordination with local Municipality. Technical assessments, prioritization, and supervision shall follow departmental standards and provincial infrastructure planning frameworks.

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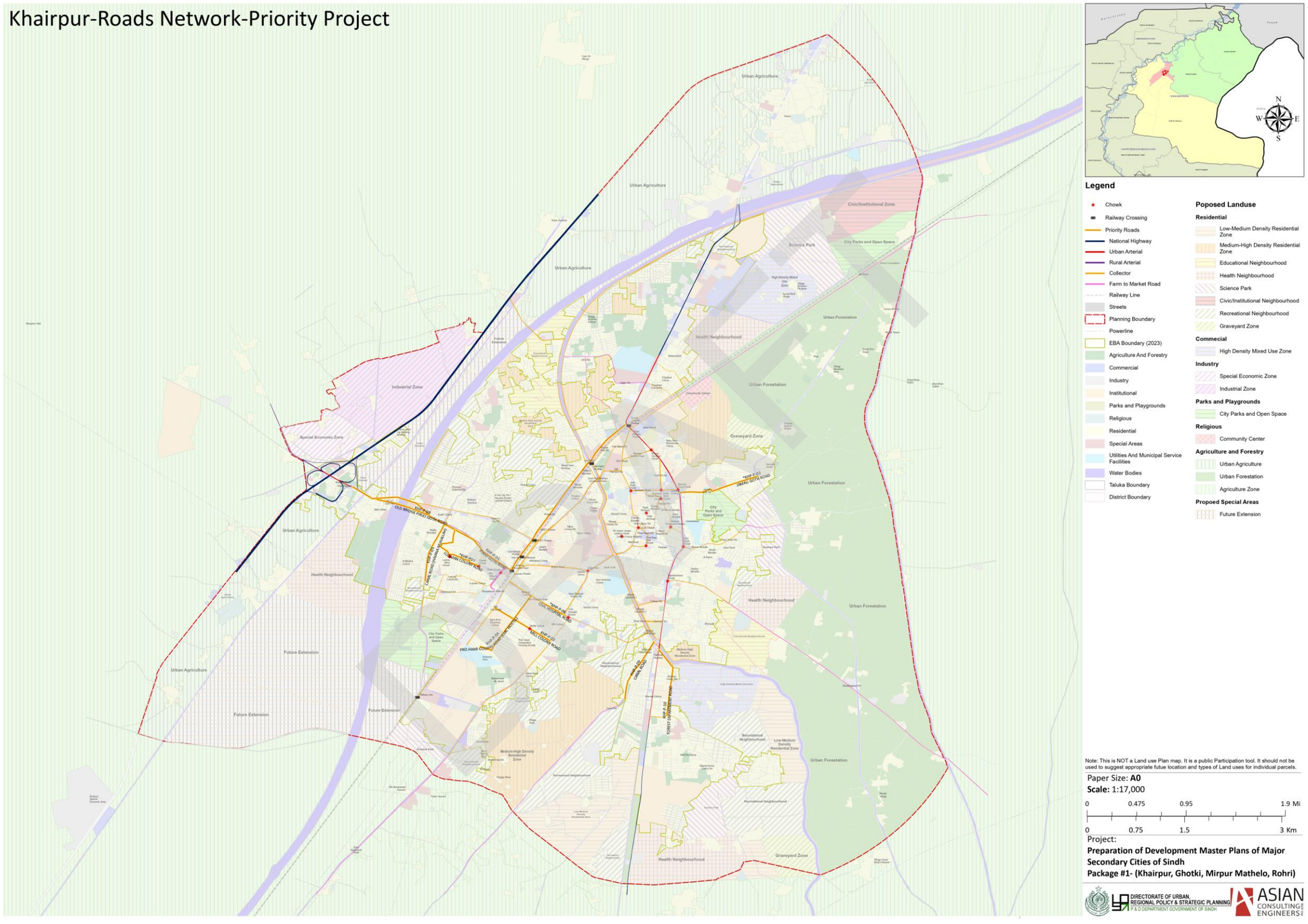


Figure 9-4, Priority Roads for Khairpur

Source: *The Consultant Team*

3. Immediate Action Plan of Core Urban Area

The condition of several roads in Khairpur's central urban area has significantly declined over recent years. Key commercial routes and residential link roads now suffer from broken surfaces, irregular widths, poor drainage, and widespread encroachments. These issues are not only affecting mobility but also contributing to traffic congestion and safety risks. This plan prioritizes the immediate rehabilitation of key roads that play a critical role in daily movement within the town. These include:

- Pirjo Goth Road– A high-traffic commercial corridor
- Jamali Goth Road– Serving busy commercial and Residential areas
- Pro. Hami Colony Road (KMC Hostel) – A key route for Residential areas
- Canal Road (Hajana Mohallah) – Connecting Agricultural and Residential areas

The rehabilitation scope includes:

- Repair and resurfacing of worn-out pavements
- Clearly marking road boundaries and restoring the right-of-way
- Introducing green medians, lane markings, and traffic signs
- Providing safe pedestrian crossings at key intersections

A key aspect of this work will be addressing encroachments. Instead of forceful removals, the plan encourages a community-driven approach involving local residents and businesses to agree on realignments. With public cooperation, we can improve road access while minimizing disruption and building a sense of ownership among the community.

Encroachments on Central Business District (CBD) roads, particularly those obstructing road width and pedestrian movement, will be removed with the support of the local administration. All rehabilitated roads will be upgraded with proper surface treatment and drainage, designed to support both vehicular and foot traffic.

Sr. No.	Name of Road	Adjacent Land use	Length (km)	Tentative Cost (Million PKR)
KHP-P-01	Pirjo Goth Road	Commercial	5.37	1149.2804
KHP-P-02	*Jamali Goth Road	Commercial / Residential	1.15	118.5975
KHP-P-03	Mill Colony Road	Residential	0.92	123.8343
KHP-P-04	Pro.Hami Colony Road (Kmc Hostel)	Residential	1.19	133.7472
KHP-P-05	Canal Road (Hajana Muhallah)	Agricultural / Residential	1.11	79.9131
KHP-P-06	*Civil Hospital Road	Mix use	0.36	40.076
KHP-P-07	*Luqman Colony Road	Residential	1.04	94.6509

**These roads are to be rehabilitated after sewerage rehabilitation.*

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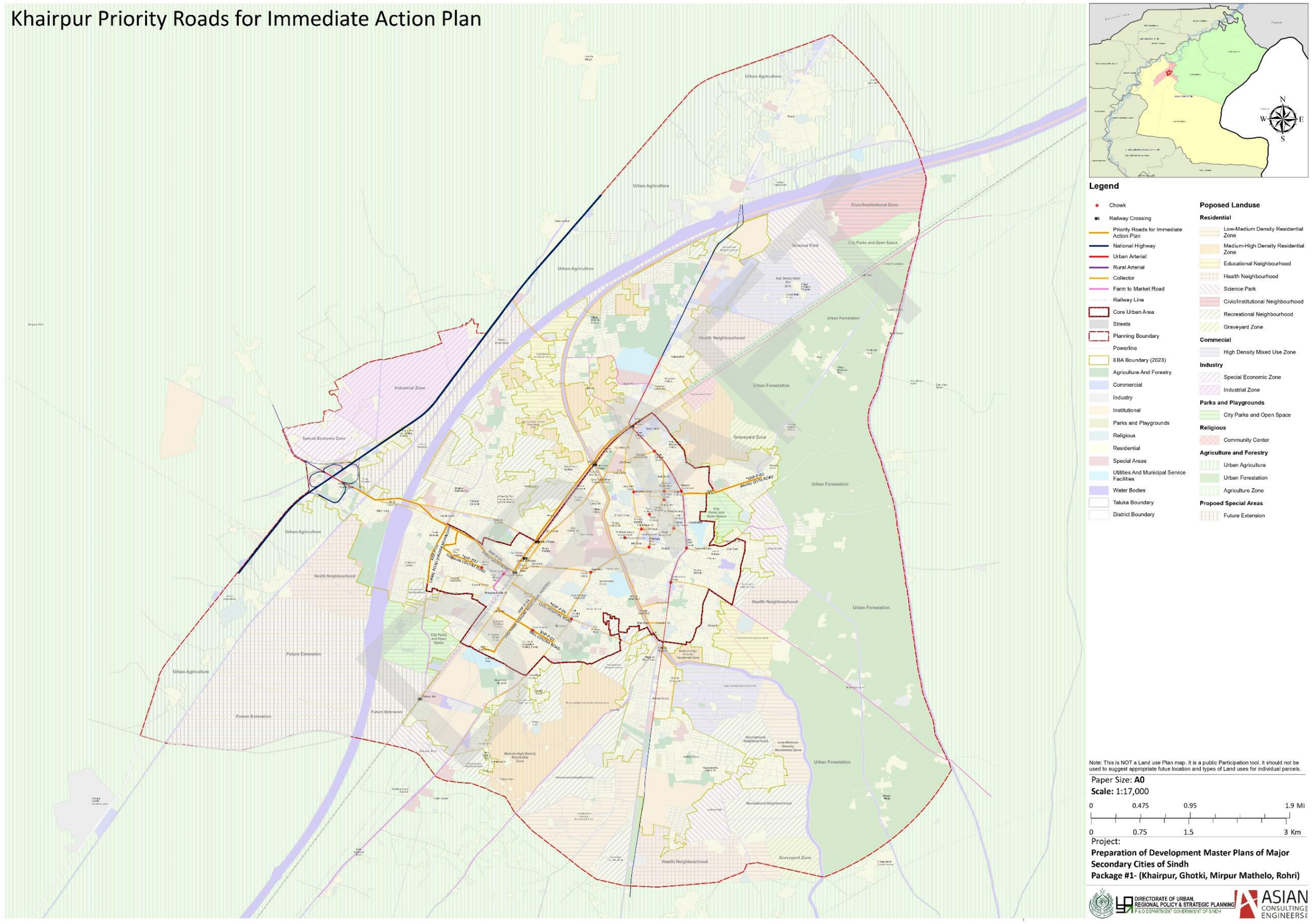


Figure 9-3, Repair & Rehabilitation & Improvement in Transport Facilities for Core Urban Area

Source: *The Consultant Team*

E) Future Roads

The future development plan for secondary cities in Sindh prioritizes a well-structured road network to enhance connectivity, accessibility, and urban expansion. The proposed road infrastructure is strategically aligned with the planned land use framework to support mobility, economic growth, and sustainable urbanization.

Additionally, existing small earthen roads and informal pathways have been identified for formal marking and potential upgrades to improve local accessibility and integrate them into the broader transportation network. This initiative ensures the preservation of vital local routes while facilitating their transition into durable, all-weather roads.

The road development strategy emphasizes sustainability, climate resilience, and efficient traffic management to accommodate future urban growth. By integrating planned and existing roads, this initiative aims to create a well-connected and future-ready urban landscape, promotion of economic and social development across secondary cities in Sindh.

Collector: These roads penetrate localities within districts and feed traffic down from the primary and secondary networks.

Arterial: Arterial roads are high-capacity roads that ensure efficient traffic flow over medium to long distances, connecting urban centres, commercial areas, and transport hubs while limiting direct property access.

Bypass: Bypass roads are roads built to divert traffic around congested or urban areas, reducing congestion, improving traffic flow, and enhancing safety by minimizing through-traffic in city centres.

The table shows the future existing and proposed roads for Khairpur city, the table describes the name/category, start end points coordinates, length, existing pavement type and the proposed ROW. The ROWs of the future roads are proposed on the basis of the NRM[17] and their categorization in the SAR report. The ROWs for the collectors are defined of 20 meters, arterials 35 meters and for the bypass roads ROWs are defined as 50 meters according to Standard Right of Ways for Urban Roads table-7.8 NRM-1986. These roads are proposed considering all the services under the berms.

The existing roads carriageway shall be remained same through the length till the city extend the ideally the proposed ROW shall be attained in the unbuilt area.

[17] *National Reference Manual on Planning and Infrastructure standards-1986, MoP Housing and Works*

Table 9-3, Long Term Action Plan Roads

Sr. No.	Road Name	Category	Start Point	End Point	Length (km)	Exisitng Pavement Type	Proposed ROW (m)
1	Sohu Kanaserah Road	Collector Road	27.496683, 68.731011	27.516692, 68.748468	2.84	Asphalt	20
2	Proposed Collector Road	Collector Road	27.499664, 68.692200	27.565121, 68.743610	8.98	Earthern	20
3	Proposed Collector Road	Collector Road	27.581425, 68.798555	27.585974, 68.761794	4.24	Asphalt	20
4	Proposed Collector Road	Collector Road	27.555021, 68.795172	27.574871, 68.782941	2.61	Asphalt	20
5	Collector Jail Road	Collector Road	27.570793, 68.798605	27.543013, 68.757236	5.17	Asphalt	20
6	Shahid Sheed Road	Rural Arterial	27.497256, 68.801001	27.521782, 68.762319	4.78	Asphalt and paver	35
7	Mirwah Road	Rural Arterial	27.481112, 68.782955	27.512149, 68.761071	4.87	Asphalt and Earthern	35
8	Proposed Urban Arterial Road	Urban Arterial	27.485979, 68.792425	27.560251, 68.790013	9.31	Asphalt and Earthern	35
9	Proposed Bypass	Bypass	27.500649, 68.688909	27.602841, 68.788001	24.9	-	50

Collector: These roads penetrate localities within districts and feed traffic down from the primary and secondary networks.

Arterial: Arterial roads are high-capacity roads that ensure efficient traffic flow over medium to long distances, connecting urban centers, commercial areas, and transport hubs while limiting direct property access.

Bypass: Bypass roads are roads built to divert traffic around congested or urban areas, reducing congestion, improving traffic flow, and enhancing safety by minimizing through-traffic in city centers.

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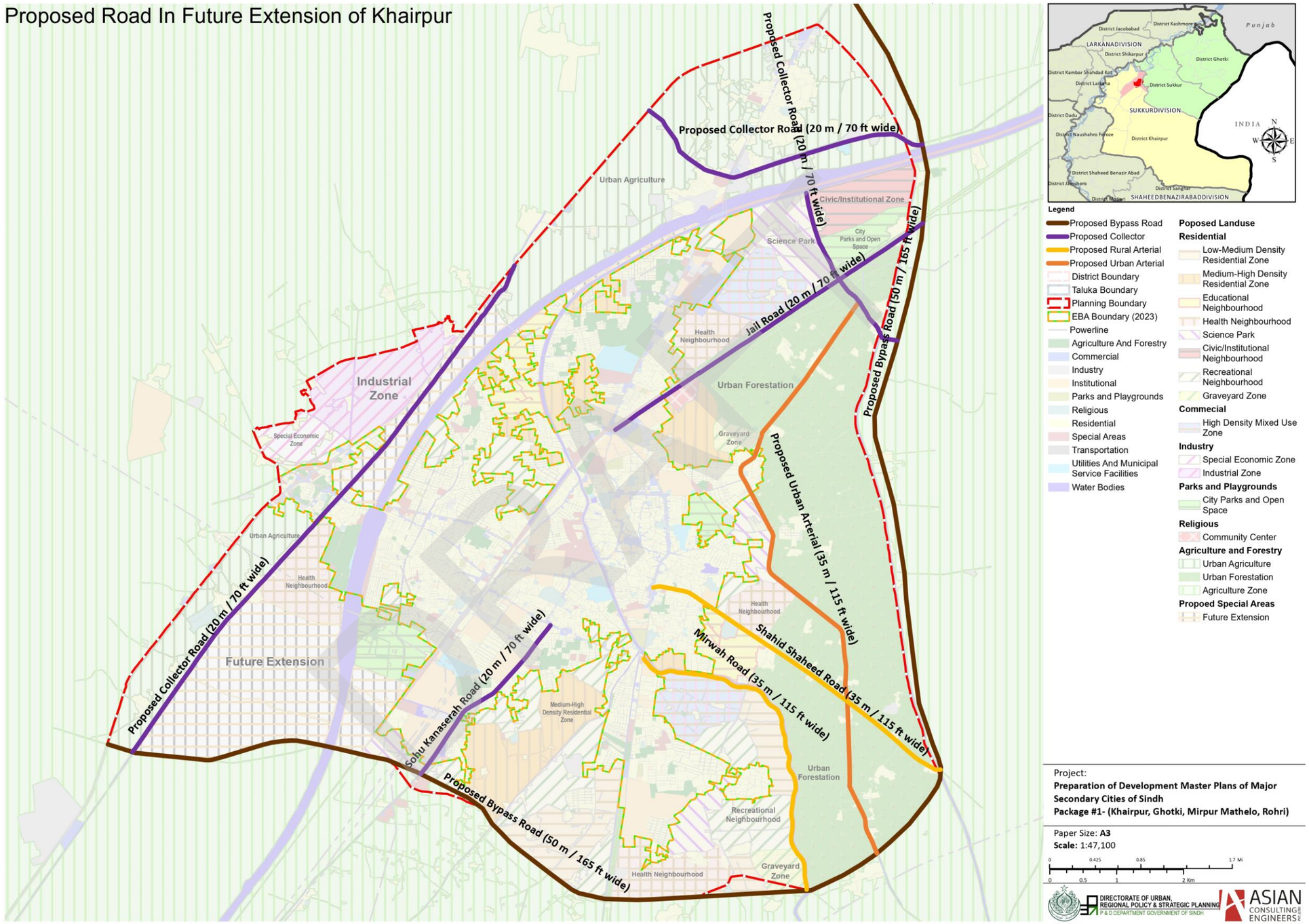


Figure 9-3, Future Roads Network Map of Khairpur

Source: *The Consultant Team*

9.3 Telecommunication

9.3.1 Existing Situation

Telecommunication services in District Khairpur remain limited, with inconsistent mobile and internet coverage across the region. Field surveys and network coverage maps indicate that while major providers such as Jazz, Ufone, Zong and Telenor offer 2G, 3G, and 4G services, the quality and availability of these services vary significantly. Many areas still lack reliable access to high-speed internet and stable mobile signals, highlighting a significant digital connectivity gap in the district.

9.3.2 Key Issues and Challenges

Field Survey provides us the data regarding the availability or non-availability of PTCL landline in respective areas of Khairpur.

There are still many houses where there is no connection of Landline. Data Collection from survey also provided us the information regarding the connections of landline in different areas of the Khairpur. The table mentioned below shows details above the connections.

Table 9-4, Availability of Telecom in Khairpur City

Parameters	Details
Total No. of Houses	2,036
No. of Houses with Landline	1,040
No. of Houses with no Landline	996
Internet provided by PTCL	547
Alternative Source of Communication	Cellular Phones

Source: *The Consultant Team*

9.3.3 SWOT Analysis

Strengths	Weaknesses
• Widespread GSM mobile coverage (2G, 3G, 4G) by all major providers. • High mobile phone penetration as alternative to landlines.	• Nearly 50% of households lack PTCL landline access. • Low PTCL internet coverage (only 547 households). • Telecom infrastructure lacks disaster resilient design and redundancy.
Opportunities	**Threats**
• Expand broadband infrastructure (fibre and wireless). • Promote affordable home internet and landline bundles. • High reliability telecom services for commercial and industrial zones.	• Overreliance on mobile data networks. • Lack of digital literacy limits internet adoption.

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9.3.4 Need Assessment

A detailed need assessment highlights the specific requirements for improving Khairpur's communication infrastructure:

Extension of Landline Connectivity:

- A significant portion of households (996) still lack PTCL landline connections.
- There is an urgent need to lay down additional copper and fibre-optic cables to expand reach.

Broadband Internet Expansion:

- Internet access is limited to 547 households, indicating low broadband penetration.
- Increasing fibre-optic and wireless broadband infrastructure is essential to bridge the digital divide.

Community Digital Awareness and Training:

- Digital literacy remains a barrier to full utilization of communication tools.
- Workshops and campaigns are required to educate residents on safe and productive internet usage, online services, and digital tools.

Disaster-Resilient Telecom Infrastructure:

- Need for redundant network routes, elevated equipment, and protected telecom installations.
- Backup power solutions (solar system and generators) for critical telecom sites.

Early Warning and Emergency Communication Integration:

- Telecom networks must support mass alert dissemination through SMS, cell broadcast, and data services.
- Integration with Disaster Management Authorities and emergency services is required.

Industrial and Commercial Telecom Requirements:

Reliable, low latency telecom services are essential for banking, logistics, trading and other industries.

9.3.5 Policy Guidelines

To promote equitable and efficient communication services, the following policy directions are proposed:

Service Obligations:

Ensure that all residents, regardless of location, have access to affordable and reliable landline and internet services.

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Incentivized Infrastructure Development:

Offer tax reliefs or public funding support to telecom providers willing to invest in underserved areas.

Public Internet Access Policy:

Establish and regulate public Wi-Fi zones in urban spaces, especially for educational and emergency use.

Digital Literacy Enhancement:

Collaborate with educational institutions and NGOs to run continuous awareness programs focused on internet safety, online transactions, and e-governance.

Performance Monitoring:

Introduce monitoring systems to ensure telecom providers maintain quality standards for coverage, speed, and customer service.

Disaster-Resilient Infrastructure Standards:

Enforce resilient design standards for telecom towers, exchanges, and data facilities.

Early Warning System Integration:

Mandate coordination between telecom operators and disaster management authorities for emergency alerts.

Industrial and Commercial Connectivity Policy:

Ensure enhanced telecom reliability and redundancy in industrial and commercial zones

9.3.6 Strategic Development Plan

Phase I (2025–2026): Infrastructure Mapping and Pilot Expansion

- Conduct a detailed GIS-based mapping of current PTCL and mobile infrastructure.
- Identification of vulnerable telecom assets.
- Begin expansion of landline services in areas with the highest communication gaps.
- Launch pilot digital literacy sessions in schools and community centers.
- Pilot integration of emergency alert systems with telecom operators.

Phase II (2027–2029): Broadband Rollout and Public Wi-Fi

- Collaborate with telecom providers to lay resilient fiber-optic networks in high-density zones with backup power solutions.

- Deploy at least 10 public Wi-Fi hotspots in central business areas and public buildings.
- Promote low-cost broadband packages for low-income households.

Phase III (2030–2032): Full Connectivity and Smart City Integration

- Aim for 100% landline and broadband coverage.
- Integrate smart communication systems into urban planning (e.g., smart poles, IoT networks).
- Digitize public services and promote e-governance through reliable connectivity.

9.3.7 Priority Projects

Landline Connectivity Expansion Project

- **Goal:** Provide PTCL landline connections to 996 currently unserved households.
- **Estimated Budget:** PKR 120 million
- **Timeline:** 12 months

Broadband Infrastructure Upgrade Project

- **Goal:** Expand fiber-optic and DSL internet coverage with redundancy, backup power and flood protection to at least 75% of the city.
- **Estimated Budget:** PKR 400 million
- **Timeline:** 18 - 24 months

Public Wi-Fi Deployment Initiative

- **Goal:** Set up 10 free Wi-Fi hotspots in key public areas.
- **Estimated Budget:** PKR 15 million
- **Timeline:** 6 - 8 months

Industrial Connectivity & Early Warning Integration Project

- **Goal:** Enable SMS and cell broadcast alerts linked with disaster management authorities and provide high bandwidth, reliable telecom services for industrial and commercial areas.
- **Estimated Budget:** PKR 25 million
- **Timeline:** 3 - 5 months

Digital Literacy and Outreach Program

- **Goal:** Conduct 100+ training sessions across Khairpur city to promote digital awareness.
- **Estimated Budget:** PKR 10 million
- **Timeline:** 12 months (recurring)

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9.3.8 Immediate Action Plan for Core Urban Area

Action	Timeline	Responsible Entity	Expected Outcome
Survey unserved areas for landline & internet	1 month	PTCL & Municipal Committee	Precise targeting of connectivity expansion
Provide PTCL landline connections to 500 homes	3 - 6 months	PTCL	50% reduction in landline gaps
Extend PTCL broadband coverage	6 months	PTCL & ISPs	200 new households connected
Install 3 public Wi-Fi hotspots (trial phase)	3 months	IT Department	Free internet access in public markets

9.4 Energy

This section scrutinizes the city's essential services in the domains of power networks to gain an in-depth understanding of their current status. Electricity is pivotal for the city's development, growth, and the quality of life for its residents. The report assesses the state of these networks, identifies opportunities and challenges, and outlines some recommendations for improvement of the power sector.

9.4.1 Existing Situation

The capacity of the Khairpur grid station is 52 MVA, there is still provision for the installation of two more 132/11 kV transformers to cater the overload condition of the grid station and to short the duration of load sheading in the area.

9.4.2 Key Issues and Challenges

Field Survey provides us the data regarding the availability or non-availability and load sheading of electricity in respective areas of Khairpur.

There are still many houses without electricity supply. The primary data collected from the city provides some insight of electricity consumptions in Units from individual sampled houses and also, it depicts the pattern of load sheading hours in different areas of the Khairpur city. The **Table** 9-5 shows the availability / non-availability of electricity, load shedding hours, as well as the alternative source of power, which people have privately installed and the total consumptions of energy by each sample household.

Table 9-5, Availability of Electricity in Khairpur City

Sr. No.	Parameters	Details
1	Total No. of Sample Houses	2,036
2	No. of Houses with Electricity	1,781

Sr. No.	Parameters	Details
3	No. of Houses without Electricity	255
4	Average Load Sheading (Hours)	5-6 hours daily
5	Alternative Source of Supply	Solar Installed on 1320 houses as alternative source of supply
6	Average Energy Consumptions per house (Units) (in summer, as the surveys were conducted in August)	0-50(78 houses) 51-100(1119 houses) 101-200(558 houses) 201-300(24 houses) Above 300 units (02 houses)

Source: *The Consultant Team*

9.4.3 SWOT Analysis

Strengths	Weaknesses
• 132/11 kV Grid Station is installed to meet the power requirements of the city. • Overhead electrification is installed to distribute the power from grid station to the residences. • Infrastructure for electricity is established for efficient distribution to the consumers.	• The generation of electricity is expensive. • There is demand and supply gap in power consumption. • The power transmission and distribution system are inefficient. • Line losses in transmission and distribution. • Infrastructure development is poor. • There is recurring issue of electricity theft. • High per unit cost of electricity to the consumers.
Opportunities	**Threats**
• To increase the power capacity, new transformers can be installed at the existing grid station. • Electricity can be generated by coal and hydel to reduce the cost of generation. • Create top of the line transmission and distribution network for increased efficiency. • Minimize embezzlement of fuel to decrease the cost of generation with fuel. • Increase the efficiency of the system to decrease the transmission and distribution losses. • Spread awareness to the	• Most of the areas lack in the general requirement of electricity. • Lack of resources to meet the supply and demand gap for electricity and gas. • Poor infrastructure can damage the equipment installed in the grid station as well as in transmission network. • Lack of awareness regarding electricity.

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consumers about the importance of electricity. • Create marketing campaigns to entice consumers. • Infrastructure development with the latest technologies and standards.	

9.4.4 Need Assessment

A comprehensive need assessment for Khairpur's energy sector focuses on addressing both the immediate and long-term challenges of power generation, distribution, and consumption. Given the current state of the power infrastructure, the following aspects are crucial for ensuring sustainable and reliable electricity access for all residents:

Expanding Power Generation Capacity:

- To bridge the existing gap between demand and supply, it is essential to increase power generation capacity. This could include both conventional power generation methods (e.g., coal, gas, fuel) and renewable sources (e.g., solar). The city's grid station is currently at 52 MVA which will require additional generation capacity to reduce the duration of load shedding.

Upgrading the Existing Grid Station and Transmission Infrastructure:

- The existing transmission and distribution systems are outdated and inefficient, leading to significant power losses and unreliability. Upgrading the grid infrastructure is vital for improving the delivery of electricity, reducing line losses, and enhancing system stability.

Reducing Transmission and Distribution Losses:

- Transmission and distribution losses reduce the overall efficiency of the power supply, impacting both the cost and quality of electricity available to consumers. These losses result from inefficiencies in the grid and theft.

Addressing Electricity Theft and Improving Grid Security:

- Electricity theft is a recurring issue that puts the strain on the power grid which leads to additional financial losses and higher electricity prices for consumers. Addressing this issue will improve both the economic sustainability of the power supply and the quality of service for consumers.

Providing Power to Underserved Areas of the City

- A significant portion of Khairpur's population is still without access to electricity. This disparity creates significant challenges for both residents and the city's overall development.

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Educating Consumers on Efficient Energy Use and the Importance of Sustainable Power Consumption

- Promoting energy efficiency and sustainability among residents can help reduce the overall demand on the power grid and encourage more responsible use of electricity.

By addressing these needs, Khairpur can enhance its electricity infrastructure, reduce power outages, and create a more sustainable energy environment for its residents. This approach will also contribute to the broader goal of ensuring that all residents have access to affordable, reliable, and clean energy.

9.4.5 Policy Guidelines

To ensure a reliable, sustainable, and affordable energy supply for the residents of Khairpur, the energy policy focuses on several key areas. The policy addresses both short-term and long-term objectives to strengthen the energy infrastructure, promote energy alternatives, improve grid efficiency, and ensure electricity access.

Below are the essential policy guidelines for the city's energy sector:

Strengthening the Existing Infrastructure

- **Objective**: The existing power grid and transmission infrastructure must be reinforced to cope with the increasing demand for electricity. This will help reduce outages, improve the quality of service, and enhance the resilience of the power system.
- **Policy Actions**:
  - **Upgrade and Expansion**: Investments to modernize and expand the grid, including transformers, substations, transmission lines, and distribution networks, especially in underserved and growing areas.
  - **Infrastructure Maintenance**: Implement regular maintenance schedules for upkeep of existing infrastructure to prevent sudden breakdowns and system inefficiencies.

Encouraging Renewable Energy Adoption:

- **Objective**: To diversify the energy mix and reduce dependence on expensive fuel-based generation, the policy should promote the use of renewable energy, particularly solar power, given its abundance and cost-effectiveness.
- **Policy Actions**:
  - **Incentives for Solar Adoption**: Provide financial incentives, tax rebates, and subsidies to households and businesses that install solar panels. These measures will help reduce initial installation costs and encourage the widespread use of solar energy.

- **Government-Backed Solar Projects**: Facilitate large-scale solar power projects, such as solar farms, to supplement the grid with clean, renewable energy. This can help meet the growing electricity demand and reduce reliance on conventional power plants.
- **Promote Solar for Off-Grid Areas**: In areas that are not connected to the main grid, solar power should be promoted as a viable alternative, with micro-grid solutions being explored for rural or remote communities.
- **Awareness Campaigns**: Run public awareness programs to educate residents about the benefits of solar energy and other renewable technologies, aiming to increase adoption rates.

Enhancing the Efficiency of the Grid and Reducing Losses:

- **Objective**: Grid efficiency must be significantly improved to reduce power losses during transmission and distribution, which not only wastes energy but also increases costs for consumers. Modernization of the grid is essential for meeting these goals.
- **Policy Actions**:
  - **Upgrade Transmission and Distribution Networks**: Replace outdated infrastructure and invest in higher-quality materials to reduce line losses. Install more efficient transformers, circuit breakers, and conductors to improve overall grid performance.
  - **Reduce Electricity Theft**: Establish stricter regulations and law enforcement to combat electricity theft, which is a significant contributor to losses. This includes surveillance, audits, and the use of tamper-resistant equipment.
  - **Demand-Side Management**: Encourage consumers to adopt energy efficient practices through time of use tariffs that reward lower consumption during peak hours.

Ensuring Access to Electricity Across All Areas of the City

- **Objective**: The energy policy must ensure that all residents of Khairpur, including those in underserved or remote areas, have equal access to reliable and affordable electricity. This will ensure greater social equity and support economic development in all parts of the city.
- **Policy Actions**:
  - **Grid Expansion to Underserved Areas**: Expand electricity distribution networks to reach areas that are currently without power, focusing on communities with limited access to the grid. This may involve constructing new substations or building additional transmission lines.

- **Subsidized Access for Low-Income Households**: Provide subsidized electricity rates or financial assistance programs for low-income households to ensure that energy costs do not become a barrier to essential services.

By adopting these policy guidelines, Khairpur can move toward a more sustainable, efficient, and equitable energy future. Strengthening the grid infrastructure, promoting renewable energy adoption, improving grid efficiency, and ensuring access to electricity will address both current challenges and future needs. These policies will not only enhance the reliability and affordability of energy but also contribute to the city's overall development and quality of life for its residents.

9.4.6 Strategic Development Plan

The Strategic Development Plan for the energy sector of Khairpur focuses on a comprehensive approach to address both the immediate and long-term energy needs of the city. This plan prioritizes infrastructure expansion, renewable energy development, modernization of the grid, and the adoption of advanced technologies to enhance grid efficiency and ensure reliable electricity supply.

Below are the key components of the Strategic Development Plan:

Investment in Infrastructure Expansion and Installation of New Power Transformers:

- **Objective**: To meet the growing demand for electricity and improve system reliability, Khairpur must invest in expanding its electrical infrastructure, especially the capacity of existing grid stations.
- **Strategic Actions**:
  - **Installation of New Transformers**: Prioritize the installation of two additional 132/11 kV transformers at the Khairpur grid station to alleviate overload conditions and reduce load shedding. These transformers should be strategically placed to handle high-demand areas and support future growth.
  - **Substation Expansion (New Grid Station)**: Expand the number and capacity of grid stations throughout the city to ensure that power is efficiently distributed to all areas, particularly underserved or high-demand zones.
  - **Strengthening Transmission Lines**: Upgrade and expand transmission lines to increase the overall capacity of the grid, reduce transmission losses, and ensure reliable power supply across all parts of the city.
  - **Grid Monitoring and Control**: Implement control systems that allow for better load management and grid stability to prevent overloads and optimize energy distribution.

Development of Alternative Power Sources:

- **Objective**: To reduce dependency on costly conventional energy sources and minimize the environmental impact of power generation, it is essential to invest in alternative power sources, particularly solar.
- **Strategic Actions**:

  Promote Solar Energy:

  - **Household Solar Programs**: Encourage the installation of rooftop solar panels in both residential and commercial buildings by providing subsidies or tax incentives. This decentralized energy solution will reduce pressure on the grid and lower overall electricity costs for consumers.

Improving the Power Distribution Network to Minimize Losses and Reduce Load Shedding

- **Objective**: Enhancing the efficiency of the power distribution network will not only reduce energy losses but also help alleviate frequent load shedding and improve the reliability of the electricity supply.
- **Strategic Actions**:
  - **Upgrade Distribution Infrastructure**: Replace outdated cables, transformers, and other equipment with more efficient and durable technology to improve the quality of electricity supply.
  - **Reduce Losses through Maintenance and Monitoring**: Implement real-time monitoring systems to track electricity consumption and pinpoint areas with high losses, ensuring urgent repairs and better load management.
  - **Address System Vulnerabilities**: Strengthen the distribution network in areas with frequent power outages and enhance the resilience of infrastructure against environmental factors (e.g., storms, flooding) that can cause service interruptions.
  - **Focus on Load Management**: Implement strategic load management techniques, such as shifting non-essential loads to off-peak hours, to reduce peak demand on the grid and minimize load shedding during high-demand periods.

Implementation Timeline and Phases:

The Strategic Development Plan should be implemented in phases, with short, medium, and long-term objectives to ensure that progress is measurable and achievable.

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- **Short-Term (1-3 Years):**
  - Begin the installation of additional transformers at key locations.
  - Launch pilot projects for solar energy adoption in residential areas.
  - Initiate the installation of smart meters and develop basic monitoring systems for grid management.
- **Medium-Term (5-10 Years):**
  - Expand the solar power program and build a utility-scale solar farm.
  - Upgrade critical portions of the transmission and distribution networks to reduce losses.
  - Implement full-scale deployment of smart grid technologies and energy storage solutions.
- **Long-Term (10-16 Years):**
  - Fully integrate renewable energy sources.
  - Installation of new 132/11 kV Grid Station.
  - Installation of new transmission lines along with the associated infrastructure.
  - Achieve a fully modernized grid with advanced automation and real time monitoring.
  - Ensure that electricity access is extended to all underserved areas of the city, and the grid is protected against environmental disruptions.

By implementing this Strategic Development Plan, Khairpur City will be able to strengthen its energy infrastructure, diversify its energy sources, reduce power losses, and improve grid reliability. These actions will not only enhance the overall quality of electricity service but also contribute to the city's sustainable development and the well-being of its residents.

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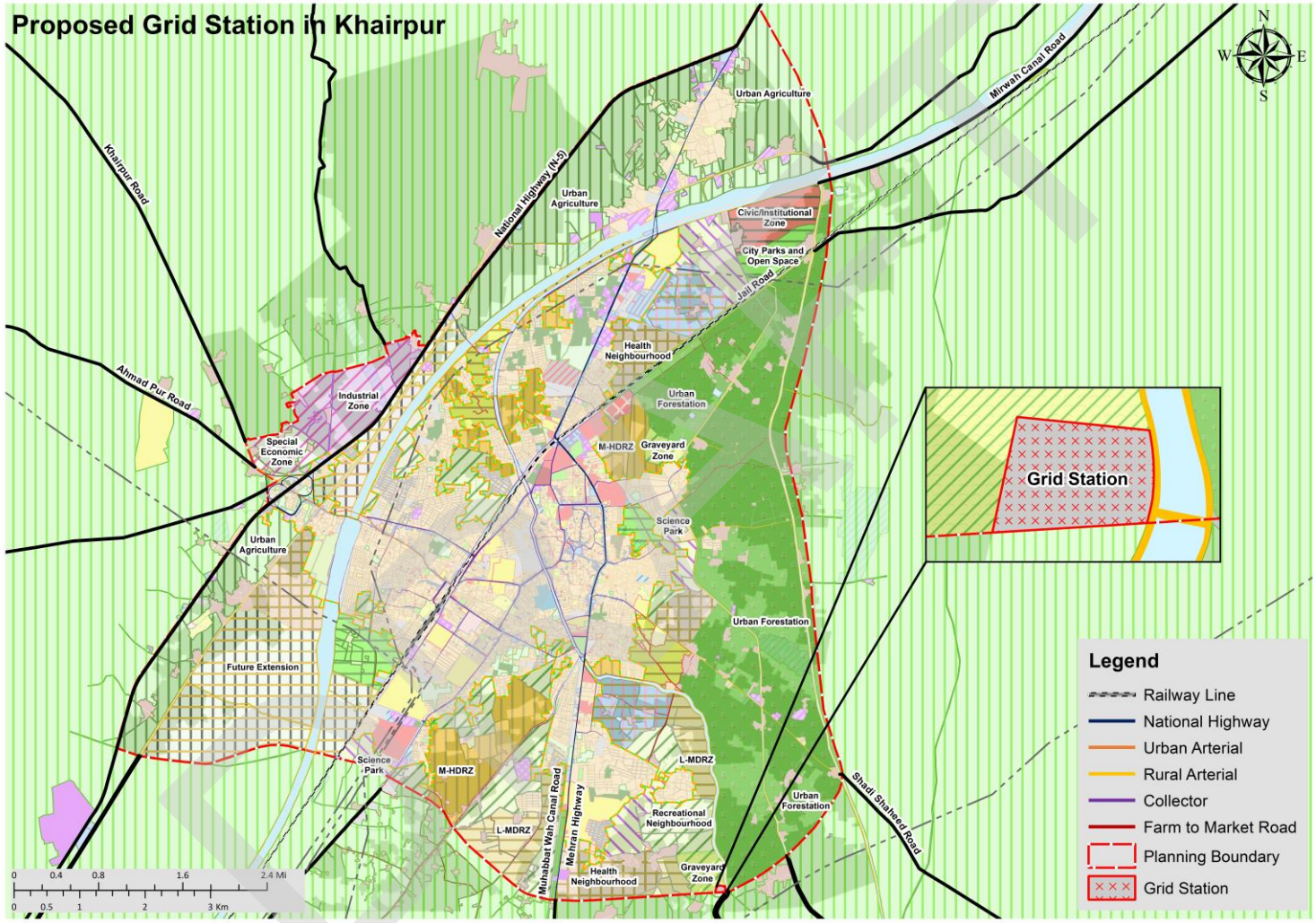


Figure 9-4, Proposed Grid Station in Khairpur

Source: *The Consultant Team*

9.4.7 Priority Projects

The Priority Projects for the power sector of Khairpur focuses on addressing the most pressing issues in the electricity supply chain, from generation to distribution. These projects are designed to ensure improved reliability, reduced load shedding and enhanced efficiency. Below are the key priority projects that should be undertaken immediately:

Installation of Additional Transformers at the Khairpur Grid Station:

- **Objective**: To address the overload condition of the current grid and reduce the duration of load shedding.
  - **Installation of Transformers**: Install two additional 132/11 kV transformers at the Khairpur grid station to enhance its capacity and support increased demand.
  - **Grid Capacity Expansion**: Ensure the new transformers are strategically placed to balance the load distribution across the city and accommodate future growth.
  - **Outcome**: The installation will reduce strain on the existing grid, lower load shedding hours, and improve overall grid stability.

9.4.8 Immediate Action Plan for Core Urban Area

The Immediate Action Plan for the core urban area of Khairpur focuses on addressing the pressing issues related to power shortages, load shedding, and energy efficiency. This structured approach aims to provide relief to residents, improve grid reliability, and promote sustainable energy practices.

- Install temporary power backup systems to reduce load shedding in critical areas.
- Begin the installation of additional transformers and network improvements.
- Promote small-scale renewable energy installations for households, such as solar panels.

9.5 Gas Supply

9.5.1 Existing Situation

This section scrutinizes the city's essential services in the domains of gas networks to gain an in-depth understanding of their current status. Gas is pivotal for the city's development, growth, and the quality of life for its residents. The report assesses the state of these networks, identifies opportunities and challenges, and outlines some recommendations for improvement of the gas sector.

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9.5.2 Key Issues and Challenges

Field Survey provides us the data regarding the availability or non-availability and load sheading of gas in respective areas of Khairpur.

There are still many houses without supply of sui gas. Data Collection from survey also provided the information regarding the load sheading hours in different areas of the Khairpur city. The Table mentioned below shows the availability /non availability load shedding hours including Alternative source of gas supply.

Table 9-6, Availability of Gas in Khairpur City

Sr. No.	Parameters	Details
1	Total No. of Houses	2,036
2	No. of Houses with Sui gas	1,692
3	No. of Houses with no connection of Sui gas	344
4	Average Load Sheading (Hours)	6-8 hours daily
5	Alternative Source of Supply	Wood and Gas Cylinders are used as an alternative source.

Source: *The Consultant Team*

9.5.3 SWOT Analysis

Strengths	Weaknesses
• Gas network is established and provides gas to the residents of the city. • Gas network has helped the users to complete everyday tasks pertaining to cooking, heating etc.	• Gas is not available to all the consumers in the city. • Gas is widely unavailable due to the poor infrastructure network.
Opportunities	**Threats**
• Installation of TBS (Town Build Station) for better distribution of gas for existing as well as new consumers. • Improvement of infrastructure gas network.	• Lack of strategic planning to implement the latest systems for gas. • Lack of advertisement to educate consumers.

9.5.4 Need Assessment

A comprehensive Need Assessment for Khairpur's gas supply network is essential to identify the specific interventions necessary to address current gaps and future challenges. Based on the existing data and issues faced by residents, the following key needs have been identified:

A. Expanding the Gas Supply to Underserved Areas

A significant portion of Khairpur's population still lacks access to Sui gas, which affects their ability to meet basic energy needs for cooking and heating. The first priority is to expand the gas network to underserved and remote areas to ensure that all households in the city have reliable access to Sui gas.

B. Upgrading the Gas Infrastructure and Flood Resilience

Gas supply issues like load shedding are a direct result of inefficient infrastructure. Areas facing supply problems or low gas pressure require immediate infrastructure upgrades, including the replacement of outdated pipes, valves, and other critical components. Additionally, installation of Town Build Stations (TBS) and other necessary infrastructure is essential to improve the distribution network, which will help to reduce load shedding and improve overall service delivery.

Underground gas pipelines are at risk of corrosion, soil erosion, joint displacement and physical damage caused by water pressure or debris movement. To enhance resilience, aging pipelines should be replaced with corrosion-resistant and high-pressure-rated materials capable of withstanding prolonged water exposure. In flood prone zones, pipelines should either be elevated where feasible or structurally reinforced with protective casing and proper anchoring to prevent displacement.

C. Raising Awareness Among Residents

A significant challenge faced by Khairpur's gas network is the lack of awareness about the availability of gas services and the benefits of direct connections. Many households still rely on wood and gas cylinders for cooking, which are less efficient and harmful to health. There is a need for a comprehensive public education campaign that informs residents about the advantages of using Sui gas, the process of obtaining gas connections, and the safety precautions necessary for handling and using gas efficiently. Educating residents will help increase demand for connections and improve the overall safety and sustainability of the gas supply system.

D. Emergency Management & Industrial Safety Protocol

An Emergency Management and Industrial Safety Protocol is essential to minimize risks associated with gas leakages, fires and industrial accidents. This includes the development of a formal Gas Emergency Response Plan outlining standard operating procedures for incident reporting, evacuation, containment and coordination with relevant emergency services. A 24/7 Gas Emergency Control Room should be established to ensure immediate response and centralized communication during emergencies. In addition, automatic shut-off valves should be installed in high-risk and industrial areas to prevent large-scale damage in case of pipeline rupture.

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E. Alternate/Contingency Planning for Industries

To ensure supply reliability and operational continuity, adoption of an N+1 redundancy system in gas supply lines is recommended. This approach will provide backup capacity in case of primary line failure, thereby minimizing the risk of production disruption and enhancing overall system reliability.

By addressing these key needs through targeted interventions, Khairpur can improve the reliability and reach of its gas supply, ensuring access for all residents while laying the foundation for a more efficient and sustainable energy system in the future.

9.5.5 Policy Guidelines

To address the gas supply issues effectively in Khairpur, a set of clear and actionable policy guidelines is essential. These guidelines will form the basis for sustainable development, equitable access, and operational efficiency within the gas distribution system:

- **Access Polic**

  Ensure 100% coverage of Sui gas in all urban and other areas of Khairpur by 2030.

- **Infrastructure Resilience Policy**

  Develop and implement standards for infrastructure upgrades, with a focus on durability, safety, and scalability.

- **Equity and Affordability**

  Introduce subsidized connection schemes for low-income households to ensure equitable access.

- **Safety and Compliance Regulations**

  Enforce strict compliance with gas safety standards through regular inspections and community outreach programs.

- **Public-Private Partnership (PPP)**

  Encourage investment from the private sector in expanding and maintaining the gas infrastructure under regulatory oversight.

- **Consumer Awareness and Support**

  Establish permanent outreach units under the utility provider to engage residents, increase awareness, and support users in accessing services.

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9.5.6 Strategic Development Plan

The strategic plan for the gas supply sector in Khairpur revolves around phased interventions, infrastructure expansion, and sustainable service delivery:

Phase I (Short-Term: 1 to 3 years)

- Complete technical assessment of current gas infrastructure.
- Begin expansion in areas with no Sui gas coverage
- Install at least 2 Town Build Stations (TBS) to improve distribution efficiency.
- Initiate awareness campaign in 3 underserved areas.

Phase II (Mid-Term: 5 to 10 Years)

- Full network coverage across suburban areas.
- Integrate smart metering and pressure monitoring systems.
- Launch mobile service units for gas safety education and connection support.
- Begin phased replacement of aging pipelines and valves.

Phase III (Long-Term: 10 to 16 Years)

- Achieve seamless service with minimal load shedding in winter (<1 hour/day).
- Implement digitized network monitoring for predictive maintenance.
- Complete replacement of aging pipelines and associated material.

9.5.7 Priority Projects

Based on the identified needs and development strategy, the following projects are recommended for immediate prioritization:

Khairpur City Gas Network Expansion Project

- **Objective:** Connect all 344 unserved households.
- **Budget Estimate:** PKR 150 million
- **Timeline:** 12 months

TBS Installation and Pipeline Upgrade Initiative

- **Objective:** Install 2 new TBS units and upgrade 15 km of gas pipelines.
- **Budget Estimate:** PKR 300 million
- **Timeline:** 18 months

Gas Awareness and Education Campaign

- **Objective:** Educate 10,000+ residents through community sessions, pamphlets, and local media.
- **Budget Estimate:** PKR 10 million
- **Timeline:** Ongoing (initial 6-month rollout)

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Emergency Repair and Maintenance Program

- **Objective:** Establish a rapid-response team with 24/7 capability for gas-related emergencies.
- **Budget Estimate:** PKR 25 million
- **Timeline:** 6 months

9.5.8 Immediate Action Plan for Core Urban Area

To alleviate the most urgent gas-related issues in Khairpur's core urban areas, the following action plan will be implemented within the next 6–12 months:

Action	Timeline	Responsible Agency	Expected Outcome
Survey and map all households lacking gas access	1 month	Gas Utility Dept.	Accurate data for targeted expansion
Begin installation of new service lines in high-priority zones	3–6 months	Contractor + Utility	Gas access to at least 200 additional households
Deploy one TBS unit near high-load-shedding zone	6 months	Infrastructure Division	30% reduction in daily load shedding
Establish 24/7 customer support and emergency line	1 month	Gas Utility	Increased response efficiency and public trust

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SECTION - 10: ENVIRONMENT

10.1 Existing Situation

Khairpur city is located in the fertile Indus River plain, within Khairpur District in the Sukkur Division of Sindh. It lies to the east of the Indus River and west of the Arore Hills. The city is traversed by two major canal systems—Mirwah Canal and Rohri Canal—which significantly shape its agricultural character and environmental context. Khairpur experiences a hot and dry climate, with summer temperatures often exceeding 45° C and low annual rainfall. This climatic condition, combined with a flat topography, makes the city vulnerable to heatwaves, water stress, and seasonal flooding. The region's environment is under increasing pressure due to unregulated urbanization, pollution, and inadequate infrastructure to cope with environmental hazards.

The soil in Khairpur exhibits a combination of fertile loam, clay, and sandy textures, supporting both agriculture and urban development. Soil tests conducted across agricultural, residential, and industrial zones revealed that most samples comply with international standards, showing no significant contamination. However, overuse of fertilizers and pesticides may pose long-term risks to soil health if not monitored.

Surface water from canals and the Indus River is critical for irrigation and municipal use. Unfortunately, water quality tests show significant contamination in the Rohri Canal, mainly due to the discharge of untreated wastewater and solid waste. Groundwater, extracted via shallow tubewells, is another vital resource but is increasingly under threat. Around 33% of groundwater samples failed to meet SEQS due to high Total Dissolved Solids (TDS), hardness, and nitrate contamination. This indicates growing pressure on water resources from both natural conditions and human activities.

Khairpur's wastewater management system is poorly developed. The city relies on a mix of open and closed drains, but only about 5% of the population is connected to a formal sewer network. The existing infrastructure includes around 11 km of sewer lines and 108 km of drains. Out of 26 disposal stations, four are non-functional, and untreated wastewater is commonly discharged into canals, open lands, or agricultural fields. There is no functional wastewater treatment plant, leading to direct environmental contamination and serious public health risks. Ponding and water stagnation are frequent in low-lying areas, especially during monsoon rains, exacerbating urban flooding and sanitation issues.

Air quality in Khairpur varies across zones. While residential and agricultural areas still enjoy relatively clean air, commercial and industrial zones have high concentrations of airborne particulate matter (PM2.5 and PM10), exceeding SEQS limits. These pollutants mainly arise from vehicular emissions, industrial activities, unpaved roads, and open burning of waste.

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Noise pollution is also a growing concern. Surveys recorded high noise levels, particularly in busy market areas, intersections, and industrial clusters. Excessive noise not only disrupts daily life but can also lead to long-term health effects like hearing impairment and stress-related conditions, especially among vulnerable populations such as children and the elderly.

Khairpur generates about 110 tons of solid waste per day. However, only 52% is collected and disposed of properly. The city lacks a formal waste segregation or recycling system, and informal waste pickers (scavengers) often handle recyclables. Waste is typically dumped in two active dumping sites, which do not meet sanitary landfill standards. This has led to uncontrolled waste accumulation, clogging of drains, and contamination of soil and water. The Municipal Committee lacks sufficient equipment, manpower, and operational budgets to manage waste effectively. There is an urgent need for capacity building and investment in sustainable solid waste systems.

The sanitation system in Khairpur is rudimentary. The city's drainage network is insufficient for its growing population, and open defecation remains a concern in some peripheral areas. Stagnant water in depression zones further worsens the sanitation situation, serving as breeding grounds for disease vectors.

Water supply infrastructure comprises tubewells along the canals and a surface water treatment plant. Around 63% of the population receives piped water through a 159 km network, supported by two functional overhead reservoirs. However, supply gaps exist, especially in unserved and peripheral areas. Water quality tests show that piped water often contains high levels of TDS and biological contaminants, indicating inadequate treatment and poor maintenance of pipelines.

Access to electricity, gas, and telecommunications is inconsistent in Khairpur. Approximately 13% of households lack electricity, 17% have no access to piped gas, and about 49% do not have active telecommunication services. Frequent power outages and voltage fluctuations are common due to overloaded and aging infrastructure. While grid stations and power lines exist, rising urban demand continues to outpace supply. Similarly, gas infrastructure is underdeveloped, and many residents rely on alternate sources such as LPG cylinders and wood, which further contributes to environmental degradation.

Despite rapid urbanization, Khairpur retains some valuable green spaces and biodiversity hotspots. The city is near the Nara Canal and Nara Desert, which support protected areas like the Takkar Wildlife Sanctuary and game reserves. These areas are habitats for endangered species such as the houbara bustard, marsh crocodile, and jungle cat. However, urban sprawl, deforestation, and agricultural encroachment threaten these ecosystems.

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Within the city, green cover is inadequate, with limited parks and tree-lined roads. There is a pressing need for afforestation, development of urban parks, and conservation of biodiversity corridors to maintain ecological balance and improve urban resilience to climate change.

10.1.1 Key Environmental Issues

- Rohri Canal surface water body in Khairpur City exhibits elevated Biological Oxygen Demand (BOD) levels, indicating a substantial organic pollution load due to untreated domestic and industrial wastewater along with microbial contamination.
- Groundwater assessment identified Total Dissolved Solids (TDS) and total hardness as the principal contaminants affecting water quality in Khairpur City.
- The wastewater samples collected from the waste drain did not meet SEQS standards due to untreated disposal of industrial and residential wastewater.
- The results from air quality monitoring in Khairpur city show that the values for PM2.5 and PM10 did not meet the SEQS standards (PM2.5: 75, PM10: 150) in commercial and residential area.
- Elevated noise levels were recorded in several locations, mainly due to heavy vehicular traffic, commercial activity, and industrial operations.
- Un-managed solid waste mechanism and improper disposal.
- Urban flooding is frequent, caused by poor stormwater drainage and low-lying depression areas across the city.
- Biodiversity and green cover are declining due to urban encroachment, pollution, and lack of green space within the city.
- Energy and utility services are unreliable, with frequent power outages, limited gas supply, and weak telecommunication coverage.

10.2 SWOT Analysis

	Internal Factors	External Factors
Positive Impacts	**STRENGTHS** • Abundant surface water resources comprise rivers and canals. Khairpur is located on the east of the River Indus. Rohri Canal is crossing the Khairpur city. The availability of these resources can be utilized by farmers for irrigation	**OPPORTUNITIES** • Surface Water, after treatment, can be used as an alternative to ground water to reduce the pressure on ground water source. • Develop and improve water supply and sanitation facilities in areas where needed. • Promote sustainable tourism, minimize harmful impacts on

	Internal Factors	External Factors
	purposes to enhance crop cultivation and increase agricultural productivity and economic development. • The availability of groundwater in the northern and eastern areas are compliance with SEQS. • Designated green space allocated for riverine forests and parks. • The Blind Indus Dolphin are found in Indus River. Some fish species was found which is used as an extractable resource for human consumption. • Agricultural areas in Khairpur maintain good ambient air quality, benefiting residents and agriculture. • Acceptable daytime noise levels in agricultural areas promote a peaceful environment.	habitats, and educate tourists on conservation. Address threats to biodiversity like habitat destruction, pollution, and overexploitation through awareness and measures to mitigate these impacts in communities, schools, and businesses. • Improving public infrastructure, such as transportation networks and facilities, encourages decreased reliance on private vehicles. This shift contributes significantly to the reduction of both air and noise pollution levels within the community. • Develop and adopt eco-friendly vehicles, alongside greener manufacturing processes within industries, utilizing cleaner energy sources and implementing carbon capture technologies to reduce emissions significantly. Encourage innovation, regulatory measures, and investment in sustainable technologies to mitigate pollution from transportation and industries.
Negative Impacts	**WEAKNESSES** • Untreated industrial and residential wastewater contaminates the Indus River and Rohri canal, leading to a decline in water quality and harming aquatic life as well as agriculture. • The groundwater quality on western side found to be in non-compliance according to SEQS mainly due to high levels of TDS, and total hardness leading to contamination. • Over-pumping in some areas of western side of city deteriorates groundwater quality, unsuitable for various uses. • The elevated concentrations of $PM_{2.5}$ and PM_{10} observed in commercial areas are primarily	**THREATS** • The disposal of untreated wastewater in the Indus River and canals adversely affects ecosystems, water quality, and agricultural viability, endangering both aquatic life and crop productivity. • Excessive or extensive use of groundwater can lead to a lowered water table. • Traffic and industrial emissions contribute to high levels of particulate matter, causing respiratory problems and impacting overall health. • Increase of private vehicles causing more air emissions, impacting air quality and public health.

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	Internal Factors	External Factors
	due to heavy traffic flow on roads and streets, while industrial activities contribute significantly to higher particulate matter levels within industrial zones leading to poor air quality. • The high level of noise in monitored areas was primarily attributed to vehicular traffic and industrial activities. • Poorly maintained old vehicles significantly contribute to heightened noise pollution. • The Khairpur district primarily found some endangered and vulnerable species. Endangered species include Marsh crocodiles, Jungle cats, Desert fox, and Smooth-coated otters. The Small Indian civet, Asiatic jackal, Birds of prey, and Game birds are classified as vulnerable while the hog deer falls under the Near Threatened category. • Decrease in green areas causes decrease in biodiversity value and disruption of ecosystem balance. • Decrease in aquatic and terrestrial biodiversity is primarily due to habitat destruction caused by human activities such as deforestation, urbanization, pollution, overfishing, and climate change. These actions disrupt ecosystems, reduce available habitats, and threaten the survival of numerous species, leading to a decline in biodiversity across both land and water environments.	• Implement sound barriers and green buffers around industrial areas, utilizing noise-reducing technologies and zoning regulations to minimize the impact of industrial noise on nearby communities. Encourage industries to adopt quieter machinery, comply with noise emission standards, and engage in community discussions to address concerns and find solutions collaboratively. • Reduction in green areas like forests and grasslands due to urbanization, deforestation, or agricultural expansion leads to the loss of habitats for various species. • Unplanned urban development diminishes green spaces, leading to disruptions in carbon sequestration, water purification, and soil stabilization. This significantly impacts the overall balance and health of ecosystems. • Industrial waste, agricultural runoff, and other pollutants impact water bodies and terrestrial environments, causing harm to various species and ecosystem in future.

10.3 Policy Guidelines

10.3.1 Compliance with Sindh Environmental Protection Act, 2014

The Sindh Environmental Protection Act, 2014 (SEPA 2014) is the basic legislative tool empowering the government to frame regulations for the protection of the environment. The SEPA 2014 is broadly applicable to air,

water, soil, marine and noise pollution. Penalties have been prescribed for those contravening the provisions of the Act. The two primary deliberations of the Act are the conduct of projects only after approval of environmental assessments from the SEPA and adherence with Sindh Environmental Quality Standards (SEQS).

10.3.2 Hazardous Substance Rules, 2014

The Sindh Hazardous Substances Rules, 2014 are a set of rules derived from the Sindh Environmental Act, 2014 and are first of the very specific hazardous substances regulations brought into force in 2014 after the initial draft set of rules devised in 2003. They represent specific regulations with aspect of handling, storage and disposal of hazardous substances and issuing an approving license to the user or facility. The Schedule-I of the Rules enlists the hazardous substances that are under the scrutiny of the Sindh-EPA.

Under its licensing terms, the Rules highlight particular components as follows:

- Employment of Qualified technical personnel
- Packing and labelling
- Conditions of Premises
- Safety precautions
- Trainings
- A comprehensive safety plans
- Waste management Plan and
- Transporting of hazardous substances

10.3.3 Enforce SEQS Compliance

All wastewater discharges (municipal and industrial) must comply with Sindh Environmental Quality Standards. Regular monitoring by SEPA and local MC is essential. All wastewater discharges monitoring will be followed as per The Sindh Environmental Quality Standards (Self-Monitoring and Reporting by Industries) Rules, 2014. In compliance to stated rules, the submission of Environmental Monitoring Reports to the concerned EPA should be enforced by SEPA officials as per the categories mentioned.

10.3.4 Mandatory EIAs for Projects

Every major infrastructure, industrial, or urban expansion project must undergo Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE) as per review of IEE and EIA regulations, 2014.

10.3.5 Issuance of Environmental Protection Order

If any environmental non-compliance including discharge or emissions of any effluent waste, air pollutant or noise or to disposal of waste or the handling of

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hazardous substance or any other act or omission is occurred or likely to be occurred, SEPA has the authority to take actions to immediate stoppage, preventing, lessening or controlling the discharges or emissions. If any entity contravenes to comply the provisions of SEPA, 2014, shall be punishable with a fine as mentioned under section 22 of SEPA, 2014 through Environmental Tribunals.

10.3.6 Enforcement Coordination with Other Departments

Under the Sindh Environmental Protection Act, 2014, the Sindh Environmental Protection Agency has regulatory authority to inspect, issue notices, and enforce compliance, and it may seek assistance from local administrations and public authorities for implementation. Practically, environmental officers routinely coordinate with Municipal Committees, PHED, Industries Department, Labour/OSH authorities, and district administration to ensure that violations are corrected and orders are enforced on ground.

10.3.7 Enforcement through EPA District Incharge

To strengthen environmental compliance and ensure effective implementation of provincial environmental regulations at the local level, enforcement responsibilities shall be supported through the office of the District Incharge of the Sindh Environmental Protection Agency (SEPA). While SEPA operates as the principal regulatory authority under the Sindh Environmental Protection Act, 2014, the presence of designated district-level officers enables decentralized monitoring, faster response to violations, and closer coordination with municipal and line departments.

10.3.8 Awareness & Community Involvement

The implementation of environmental projects cannot be achieved without public awareness and community involvement. Current issues being faced at Khairpur city like sanitation, solid waste improper disposal, littering and illegal dumping are because of unfamiliarity and unawareness of environmentally sustainable practices. For this purpose, community involvement sessions are an integral part of implementation of safe environmental practices. The Master plan adopts a community centered approach to improve community behavior towards environmental initiatives. Structured awareness campaigns will be undertaken through local media, community forums, and public outreach initiatives to educate residents on waste segregation, proper disposal practices, sanitation, water conservation, and the health and environmental risks associated with poor practices.

A. Collaboration with Educational Institutes

Engage educational institutions as key partners through school based environmental programs, clean up drives and plantation initiatives to foster long-term behavioral change among youth. Involve community groups, local leaders and civil society organizations in neighborhood monitoring, reporting of illegal dumping or drain obstruction and supporting maintenance of green spaces.

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Arrange awareness seminars for colleges for solid waste segregation practices, introducing concept for circular economy and water recycling initiatives.

B. Collaboration with Industries

Set up engagement companies with industries, markets and business to further promote environmental compliance and resource recovery practices.

These initiatives will be implemented in a phased manner, with initial awareness and pilot programs in the short term, citywide roll-out and institutionalization in the medium term, and integration into routine municipal operations over the long term. By embedding community participation within all environmental interventions, the Plan ensures improved service efficiency, reduced operation and maintenance costs, enhanced climate resilience, and long-term sustainability of infrastructure investments.

10.4 Strategic Development Plan

10.4.1 Priority Projects (Upto 5 Years)

A. Sewerage and Drainage

To prevent untreated wastewater discharge into Rohri Canal under Basic utilities section of this report following projects are proposed.

Sr. No.	Link to Basic Utilities	Environmental Intervention	Key Environmental Outcome
1	Installation of New Sewerage and Drainage Network (67 %)	Extend piped sewer coverage citywide	Reduction in open wastewater/ surface water
2	Rehabilitation of 33% existing network	Prevent sewer overflows and leakages	Protection of groundwater from contamination
3	Phase-1 WWTPs (15 & 10 MGD)	Initiate wastewater treatment	Initial compliance with SEQS and pollution load reduction
4	Drain rehabilitation and cleaning	Improve flood and stormwater management	Reduced urban flooding and stagnation
5	Rehabilitation of Disposal stations	Strengthen disposal station efficiency	Reliable sewage conveyance and reduced backflow

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B. Improving Water Supply

Sr. No.	Linked Utility Intervention	Environmental Action	Environmental Outcome
1	New water supply network (2100 acres)	Provide new water network to 37% unserved area	Reduce informal groundwater extraction
2	Rehabilitation of degraded water supply network (3945 acres)	Rehabilitate 63% degraded network	Reduce chances of leakages to avoid ground water contamination.
3	WTP repair (Khakhee Shah + abandoned plant)	Rehabilitate surface water treatment plant	Availability of clean water to residents
4	Storage Expansion 13 OHR	Expand Storage for more availability.	Supply reliability during peak hours

Objective

Improve drinking water reliability and reduce environmental stress caused by informal extraction methods.

C. Solid Waste Management

The following priority projects are proposed to strengthen the solid waste management system of Khairpur City during the short-term planning horizon, focusing on improving collection efficiency, controlled disposal, and environmental compliance

Sr. No.	Linked SWM Intervention	Environmental Action	Environmental Outcome
1	Phase-1 landfill development	Replace open dumping with engineered disposal	Protection of groundwater
2	Material Recovery Facility (MRF)	Reduce landfill burden through recycling	Waste diversion & resource recovery
3	Transfer stations & transport vehicles	Improve transport efficiency	Reduced fuel consumption & emissions
4	Community awareness programs	Introduce waste segregation at source	Improved recyclables recovery
5	Landfill monitoring system	Establish environmental monitoring at disposal sites	Compliance with SEQS

Objective

Shift from uncontrolled dumping to environmentally managed waste disposal system.

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D. Air Quality Management

To address the increasing environmental pressures resulting from urbanization and industrial activities, a phased approach toward strengthening municipal environmental governance is proposed

1. Municipal Environmental Management & Monitoring Unit

As a priority intervention, a Municipal Environmental Management & Monitoring Unit shall be established within the Municipal Committee to institutionalize environmental oversight. The unit will be responsible for monitoring ambient air, water, soil, and noise levels in accordance with SEQS and WHO guidelines. It will conduct periodic sampling, maintain environmental databases, analyze trends, and coordinate with Sindh EPA for enforcement actions.

Objective

Establishment of monitoring unit will provide the institutional backbone required for regulatory compliance and evidence-based environmental planning.

Governing Body

MC Khairpur with coordination of District Incharge, SEPA.

2. Implementation of Air Quality Management System

Following institutional strengthening, an integrated Air Quality Management System (AQMS) shall be developed. This will include installation of real-time ambient air monitoring stations at strategic residential, commercial, and industrial locations. The monitoring data will be integrated into a centralized municipal dashboard to track pollution trends, identify hotspots, and inform urban planning decisions.

Objective

Public disclosure of air quality indices will also enhance transparency and community awareness

Governing Body

MC Khairpur with coordination of District Incharge, SEPA.

3. Urban Green Spots

Plantation of native trees along major roads, drains and open spaces. Convert vacant plots and roadside margins into community green spaces.

Objective

Plantation of native species will reduce $PM_{2.5}$ and PM_{10} in air, increase climate resilience, urban heat resilience and habitat development and restoration

Governing Body

MC Ghotki with coordination of District Incharge, SEPA

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10.4.2 Long-Term Plan (Upto 2043)

A. Improvement of Sewerage and Drainage

Sr. No.	Link to Basic Utilities	Environmental Intervention	Key Environmental Outcome
1	Construction of 15 MGD & 10 MGD WWTPs	Eliminate direct sewage discharge into canals	Full compliance with environmental standards
2	Complete trunk sewer network (Zone 1–3)	Achieve universal sanitation coverage	Citywide public health protection
3	Citywide sewer network expansion	Achieve 100 % service coverage	Improved public health protection
4	Effluent reuse system	Implement treated wastewater reuse	Reduced freshwater demand & circular water management
5	Pump station expansion & storm upgrades	Improve climate resilience of drainage system	Protection from extreme rainfall events
6	Sewer asset management system	Develop GIS-based asset & monitoring system	Sustainable O&M and performance tracking
7	Pollution load reduction from full treatment	Restore receiving water bodies ecosystem	Improved aquatic health and biodiversity

B. Water Supply

Sr. No.	Link to Basic Utility	Environmental Action	Environmental Outcome
1	Hydraulic modelling and pressure optimization (WaterGEMS-based planning)	Develop aquifer sustainability plan	Develop full 9-zone interconnected looped network
2	Tube well Expansions	Planned Tube Well Expansion with Canal Recharge Strategy	Long-term water security to protect aquifers
3	25 OHRs citywide	Optimize storage for future demand	Drought resilience
4	Implementation of groundwater quality monitoring (TDS & chemical testing)	Monitor and regulate drinking water sources	Protection against long-term contamination risks
5	Canal recharge-based groundwater abstraction strategy	Protect recharge zones and manage abstraction sustainably	Long-term aquifer sustainability

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C. Integrated Solid waste Management

Sr. No.	Linked SWM Intervention	Environmental Action	Environmental Outcome
1	63.7 -acre engineered landfill	Develop full sanitary landfill system	Long-term containment of waste
2	LFG collection system	Implement landfill gas capture	Methane reduction & climate mitigation
3	Composting / Anaerobic digestion	Promote organic waste processing	Reduced organic landfill load
4	Reject fraction utilization	Introduce waste-to-energy feasibility	Reduced landfill dependency
5	Capacity building & PPP models	Strengthen institutional & regulatory framework	Sustainable service delivery
6	Recycling expansion	Implement circular economy framework	Resource efficiency

D. Industrial Air Pollution Control Incentive Framework

Based on monitoring evidence and regulatory assessments, a financial incentive framework shall be introduced to support industries in installing approved air pollution control systems such as bag filters, electrostatic precipitators, and scrubbers. Subsidies or soft-loan mechanisms may be developed in coordination with provincial authorities to facilitate compliance.

Objective

This intervention will reduce particulate matter and gaseous emissions, contributing to sustained improvement in ambient air quality.

E. Climate-Resilient Urban Forestry System

Establishment of urban development zone, ecological corridors connecting green areas and adaptation of carbon sequestration strategy with strategic planning of year 2043.

10.5 Institutional & Financial Sustainability

Effective environmental governance requires continuous monitoring, transparent reporting, and corrective action.

Sindh Environment Protection Agency	SEPA will retain its mandate as the primary regulatory authority responsible for environmental approvals, monitoring, and enforcement, including inspections and compliance actions under the Sindh Environmental Protection Act, 2014
EPA District Incharge	At the district level, the EPA District Incharge will facilitate routine oversight, field inspections, and coordination with local departments to ensure timely implementation of environmental safeguards.

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Environmental Management Unit	Environmental Management Unit within the local government structure is recommended to oversee environmental planning, data management, reporting, and liaison with SEPA in terms of solid waste management, drainage, wastewater systems, parks and green spaces.

- The Master Plan adopts a phased and diversified financing approach to ensure that investments remain affordable and financially viable. Basic public service functions such as drainage improvement, green infrastructure, and environmental monitoring will be supported through provincial and municipal development budgets.
- To control long-term costs, environmental systems will prioritize energy-efficient technologies, decentralized and modular solutions, and preventive maintenance practices that reduce operational expenses and extend asset life.

10.6 Financial Planning and Cost Estimates

This section presents indicative financial estimates for priority projects proposed under Strategic Development Plan.

Sr. No.	Project Title	Coverage / Capacity	Estimated Cost (Million PKR)
Drainage and Sewerage Management			
1	Installation of New Sewerage & Drainage Network	2.632 acres	4,186.5
2	Rehabilitation of Existing Sewerage Network	1312 acres	
3	Construction of Phase-1 Wastewater Treatment Plants	15 MGD + 10 MGD	
Water Supply Management			
1	Provision of New Water Supply Network (Urban Boundary except Core Area)	2,026.3 Acres	2,432
Solid Waste Management			
1	Procurement of Transport Fleet (Compactors, Arm Roll, Trolleys etc.)	From Equipment Table	1,545
2	Development of Transfer Stations	Lump-sum estimate	
3	Construction of Maintenance Workshop	As per workshop costing	
4	GPS & Fleet Management System	Included in monitoring & digital systems	
5	Phase-1 Engineered Landfill Development	63.7 acres	

Sr. No.	Project Title	Coverage / Capacity	Estimated Cost (Million PKR)
		total; phased initial cell (~10 acres equivalent)	
6	Material Recovery Facility (MRF)	From advanced facilities	
Air Quality Management			
1	Municipal Environmental Management & Monitoring Unit Lab setup (furniture, systems, workstation)	Lump sum	185
	Water Sampling and Analysis equipments	Lump sum	
	Ambient Air Monitoring Station	1	
	Noise Meter	1	
	Sampling Vehicle	1	
	O & M Cost* (Lab staff salaries, calibration, maintenance and lab consumables)	Lumpsum	
2	AQMS Procurement	3	
Plantation of Native Species			
1	Plantation of native species along boundary of canal, open spaces	8000	15.5

10.7 Immediate Action Plan (0-2 years)

Project Name	Description	Cost (PKR) Million
Municipal Environmental Management & Monitoring Unit	Low-cost environmental testing lab to support SEPA and MC in routine analysis and compliance.	50
Provision of New Water Supply for Khairpur City	Development of a comprehensive piped water supply network to ensure safe, reliable, and equitable drinking water access for the entire population of Khairpur City.	715.5
Repair and Rehabilitate Existing Drainage System	Desilt, reconstruct, and extend broken and undersized drains in urban Khairpur.	373.5
Elimination of open waste dumping, improvement of collection coverage	Increase in collection machinery and workforce, designated temporary storage points and route optimization for collection and handling of solid waste.	650
Tree Plantation	Plantation of native species around canal area, open spaces and green belt	15.5

10.8 Project Integration

The proposed environmental projects under the Strategic Development Plan are designed as an integrated framework that collectively addresses water pollution, groundwater depletion, solid waste mismanagement, air quality deterioration, and institutional gaps in environmental governance.

The expansion of sewerage networks and phased development of wastewater treatment facilities will significantly reduce untreated discharge into surface water bodies, thereby lowering organic pollution loads and protecting aquatic ecosystems. Simultaneously, universal water supply coverage and groundwater monitoring strategies will reduce dependence on unsafe informal extraction methods and promote sustainable aquifer management. Improved solid waste collection, transfer systems, and engineered landfill development will prevent open dumping, reduce leachate contamination, and minimize drain blockages and urban flooding.

The establishment of a Municipal Environmental Management & Monitoring Unit along with a real-time Air Quality Management System will strengthen regulatory enforcement, ensure SEQS compliance, and support evidence-based planning. Together, these coordinated interventions shift Khairpur' s environmental management approach from reactive control to proactive, sustainable urban environmental governance aligned with the 2043 development vision.

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SECTION - 11: DISASTER MANAGEMENT PLAN

11.1 Introduction

This section provides an overview of Khairpur's existing situation and its district disaster risk context. It highlights natural hazards such as floods, droughts, heatwaves, and earthquakes, along with man-made risks including fires, terrorism, and accidents. The section further identifies key challenges in mitigating these disaster threats and outlines the disaster management framework, emphasizing the roles of local authorities, emergency services, and coordination with agencies like NACTA. Additionally, it presents policy guidelines and strategic priorities aimed at effective disaster risk reduction and building resilience.

11.2 Existing Situation

Khairpur District, including the Khairpur city, is highly vulnerable to both natural and man-made hazards. Its proximity to the Indus River, combined with climatic variability and inadequate infrastructure, exposes the district to frequent floods, droughts, and extreme heatwaves. Additionally, the district faces significant risks from large-scale accident events, including terrorism and social unrest. Rapid urbanization has further exacerbated these vulnerabilities, particularly increasing the frequency of urban flooding and water scarcity. The following section details the specific disasters and risks affecting Khairpur city and district at large.

11.2.1 Disaster Risk and Vulnerability

A. Demographic Overview and Vulnerable Population

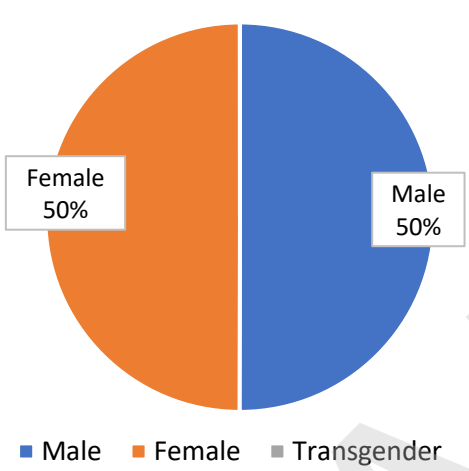
The demographic overview of an area provides a snapshot of its population characteristics. This includes information on the total population size, ethnic composition, language spoken, and religious affiliation. Demographic data is essential for understanding the social and cultural diversity of a region, as well as the socioeconomic factors that shape its communities. It serves as a vital resource for government planning, resource allocation, and policy development, helping to address the unique needs and challenges of the area's residents. The demographic overview paints a dynamic picture of the area's past, present, and future, providing a foundation for informed decision-making and effective community development initiatives[18].

1. Vulnerable Groups

Vulnerable groups in Taluka Khairpur extend to poor families, who face poverty-related issues, and minority communities, who may experience discrimination and reduced access to services[19]. As in many rural areas,

[18] *A GIS-based technique analysis of land use and land cover change detection in taluka Khairpur: A case study in district Khairpur, 2021*
[19] *Https://Placeandsee.Com/Wiki/Khairpur*

people with disabilities, especially those living in underprivileged circumstances, face challenges related to accessibility and social inclusion. Further, vulnerability can also be referred as vulnerable age groups which include elder and younger population of community. Understanding the unique needs of this vulnerable age groups is essential for developing targeted interventions and policies that enhance the overall well-being of Taluka Khairpur's residents.



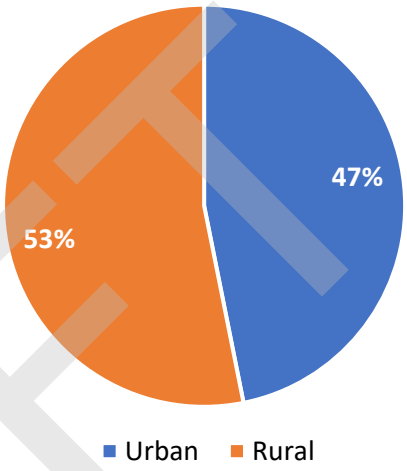


Figure 11-1, Gender Distribution (2023) **Figure 11-2, Urbanization (2023)**

Source: *Pakistan Bureau of Statistic 2023*

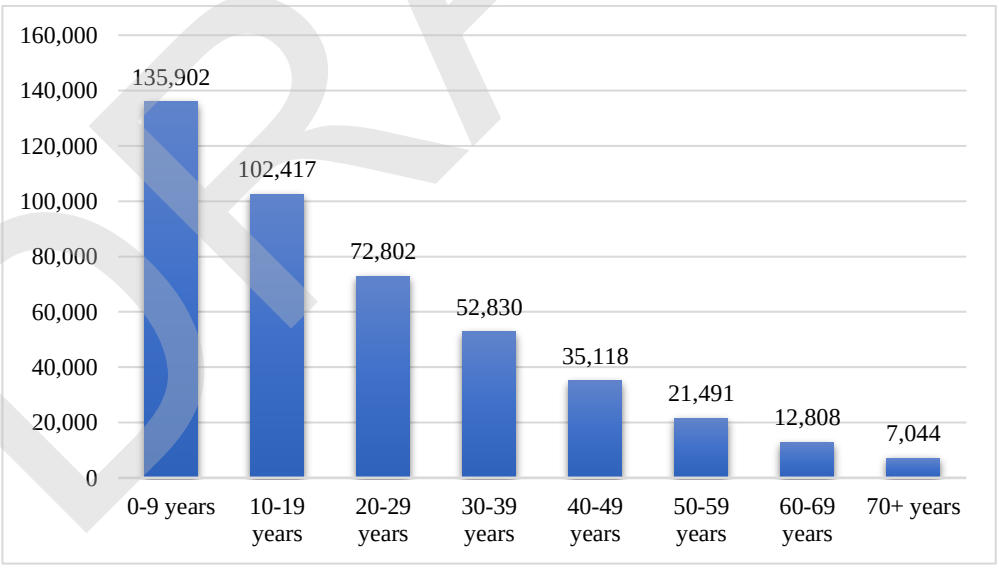


Figure 11-3, Age Group Distribution (2017)

Source: *Pakistan Bureau of Statistic 2017***

***2017 age-wise distribution data is utilized because the 2023 census data for age distribution in urban localities is not yet available.*

Women, children, people of old age, and People with Disabilities are always considered as the most vulnerable elements and normally suffer more than others during any kind of disaster. Their involvement is vital for effective

disaster risk management. In a disaster situation, there is need to particularly focus on gender equality and the specific needs of females, children, people of old age, and PWDs before, during, and after the disaster events [20].

2. Migration and Mobility

Over the years, labor migration has been common, with people from Khairpur seeking work in cities or other countries to support their families. They often find employment in construction, manufacturing, and other sectors. Like many rural areas, Khairpur has witnessed urbanization. People from the surrounding rural areas have migrated to the town in search of better economic opportunities and access to services and education. Apart from international migration, there's been a significant internal migration within Pakistan. People from rural Sindh, including Khairpur, often move to cities like Karachi, Lahore, and Islamabad in search of better economic prospects. The development of transportation infrastructure, including roads and railways, has also played a role in the mobility of people in and out of Khairpur. Improved connectivity has facilitated trade, tourism, and labor migration[21].

B. Critical Infrastructure under Flood (2022), MC Khairpur

Figure 11-4 shows the critical infrastructure under floodwater in District Khairpur and gives a comprehensive visual representation of the profound impact of floodwater on essential services and facilities like the transportation network, educational institutes, and parks which were at risk at the time of disaster. The floodwater extent covers a small patch of MC Khairpur but turns the affected area under high-risk and disconnects the intercity linkages.

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[20] *DDMP District Khairpur (July 2018 - June 2023), 2018*
[21] *Family Advancement for Life and Health, 2010*

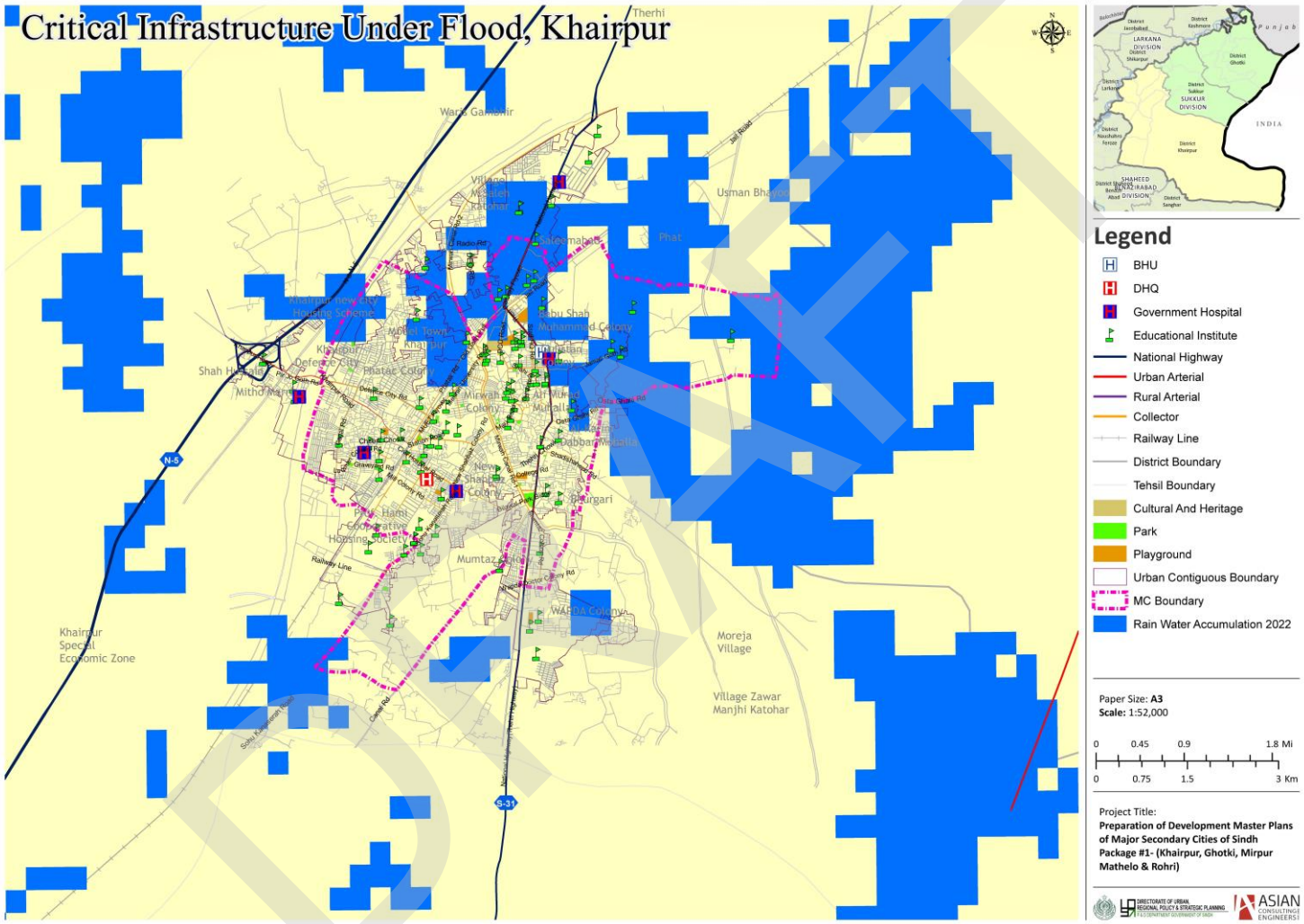


Figure 11-4, Critical Infrastructure Under Flood, Khairpur

Source: *The Consultant Team, 2023*

1. Population under Flood (2022), MC Khairpur

Figure 11-5 gives a visual representation of the population affected by the floodwater in MC Khairpur. It highlights the low, medium, and highly affected zones depending on the population density. The map illustrates the spatial distribution of communities and settlements as well as overlays the floodwater extent identifying the severely affected areas. A maximum area with low population density, a minimum percentage of medium population density, and high population density is affected by floodwater in MC Khairpur.

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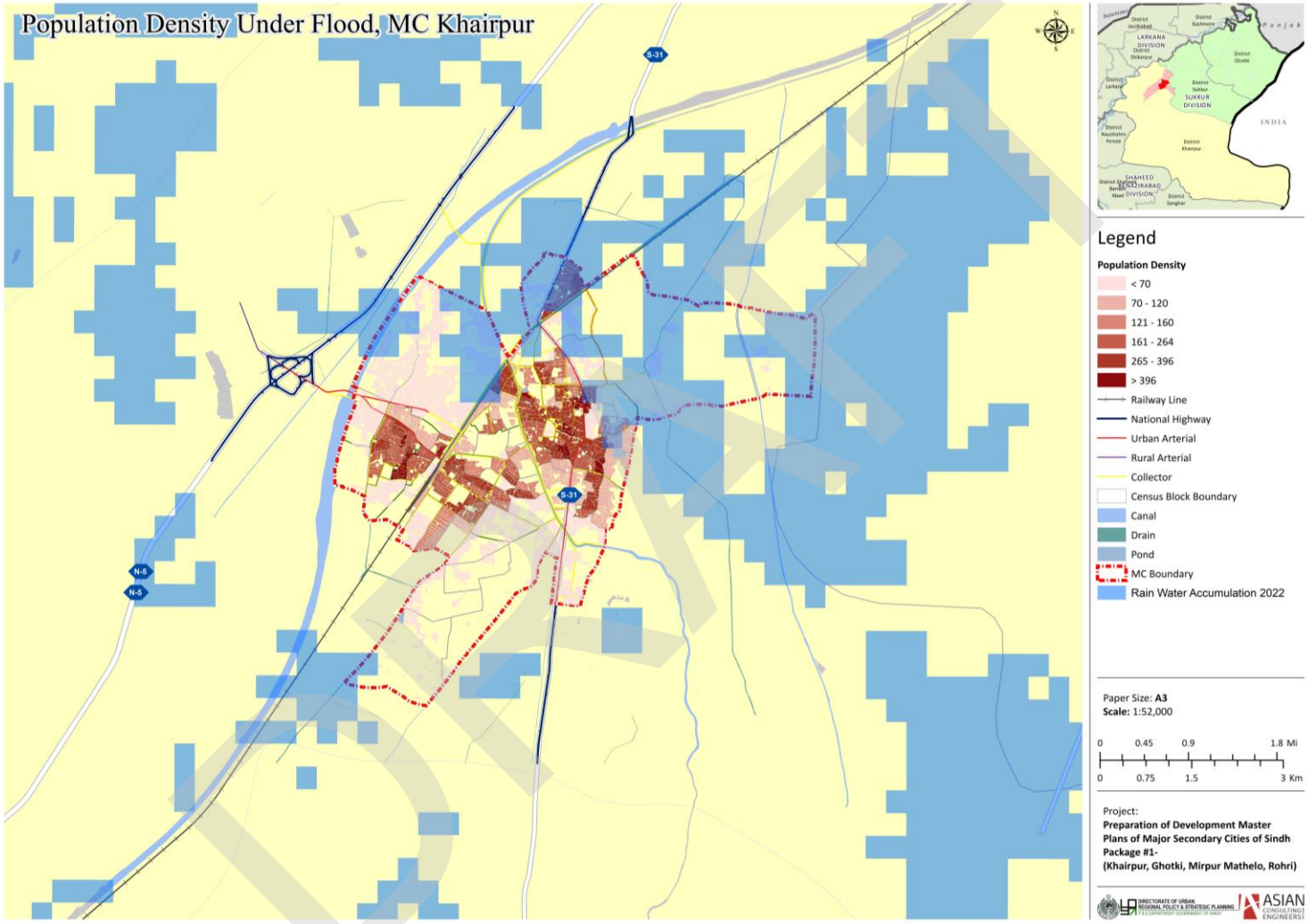


Figure 11-5, Population Density V/s Flood Extent, MC Khairpur

Source: *The Consultant Team, 2023*

11.3 Hazard Profile

Khairpur District, situated on the eastern bank of the Indus River in Sindh province, is geographically positioned in a region highly susceptible to a range of natural hazards. These include recurrent floods, extended droughts, intense heatwaves, and occasional earthquakes. The convergence of climatic vulnerabilities, an overburdened infrastructure system, and high population density amplifies the disaster risk profile of the city. As urbanization continues and climate change intensifies, the frequency and severity of such hazards are expected to increase, making disaster preparedness a critical component of the planning framework.

11.3.1 Flood

A. Provincial Profile

Flood 2022 in Pakistan is a historic event. Sindh has been among the most affected areas while a record-breaking precipitation was observed in most parts of the province. Due to various human and natural causes dewatering process in province is slow. The rain water accumulation was further aggravated due to coincided water flows from Baluchistan and flooding in river Indus. Overloaded irrigation and drainage networks breached and dewatering process became more difficult. Cumulative effects caused large tract of most populated lands of the province to go under water and the population and livestock in millions and crops in thousands of acres got affected. The situation during flood 2010 was much alike but in 2022 both right and left banks of Indus were simultaneously were affected which resulted in large scale disturbance. Resources of government were stretched to the limits and the international community came to assist the government and the affected community.[22]

Consecutive and continuous heavy rain spells flooded almost entire populated area of the province. Map below shows flood inundation as of August 28, 2022. As a result, huge number of homes were damaged leaving thousands of families dispersed in camps and other safe places. Secondary problems like malaria, cholera, diarrhoea, dengue, and other infectious diseases were raised due to abundance of water around human settlements.

[22] *(Flood 2022 in Sindh, PDMA - Sindh 2022, n.d.)*

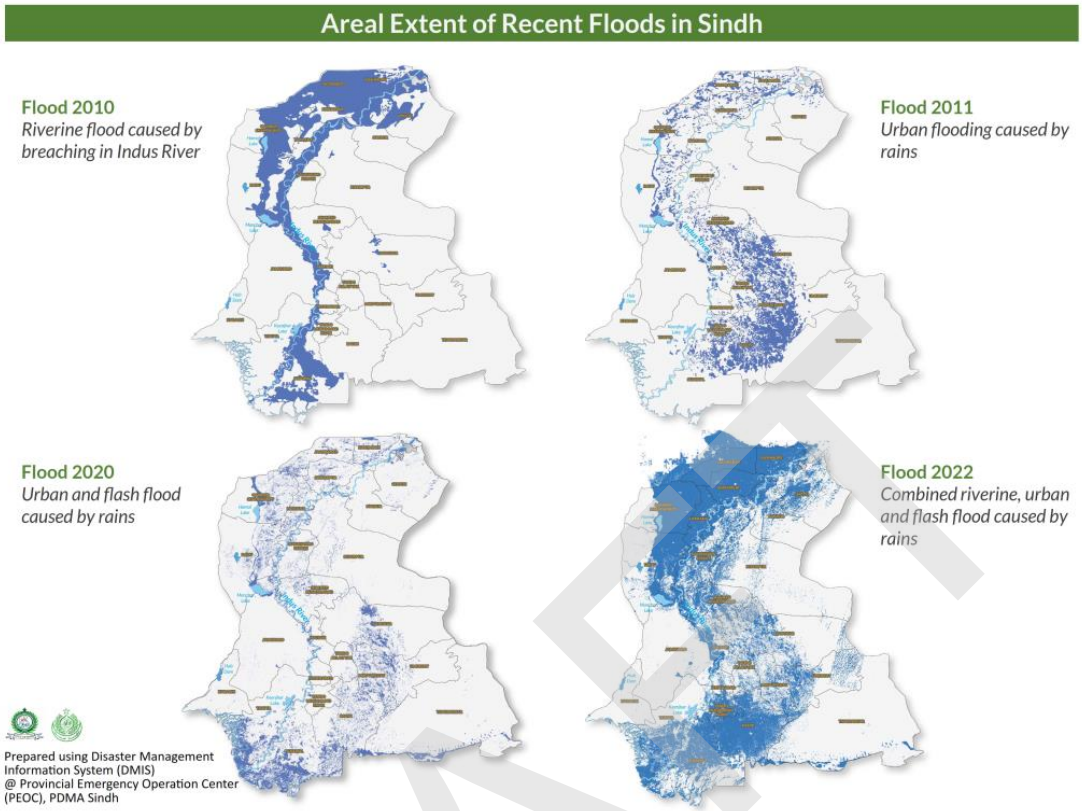


Figure 11-6, Comparison of Flood Water in Sindh Each Year: 2010, 2011, 2020, 2022[23]

***Source**: PDMA Sindh 2022*

Above figure depicts the area of flood water in Sindh for the years 2010, 2011, 2020, and 2022. In 2010, a breach in the Indus River caused flooding in the province, and the following year, high rains caused urban flooding, which became the cause of floods, leading to significant damages to human life, livestock, and infrastructure. After 9 years, significant rains brought floods again in 2020, and in 2022, causing urban, flash, and riverine flooding throughout the region.

It can be seen from the extent maps that compared to previous floods of 2010, 2011 and 2020, the spatial extent of recent flood of 2022 is multifold while the damages have been devastating. This kind of extent has become a major concern for those responsible for disaster management in the area.

23 (Flood 2022 in Sindh PREPARED BY PDMA, 2022)

Table 11-1, Losses and Damages in Sindh caused by Flood 2022[24]

Losses and Damages in Sindh caused by Flood 2022		
Deaths and Injuries	Deaths	823
	Injuries	8,422
	Livestock	436,435
Infrastructure Damages	Houses (Count)	2,087,186
	Roads (Km)	8,463
	Bridges (Count)	165
	Causeways (Running	2,125
Population Affected	Affected Population	12,356,860
	Displaced Population	7,383,023
Crop Damages	Acres	3,777,272

Source: *PDMA Sindh, 2022*

B. District Profile

Flooding is arguably the most prevalent and destructive hazard in Khairpur. Its location near the Indus River and the extensive irrigation system, exposes the city to seasonal floods, especially during the monsoon period. In 2010, a breach in the Indus River caused flooding in the province, and the following year, high rains caused urban flooding, which became the cause of floods, leading to significant damages to human life, livestock, and infrastructure. After 9 years, significant rains brought floods again in 2020, and in 2022, causing urban, flash, and riverine flooding throughout the region.

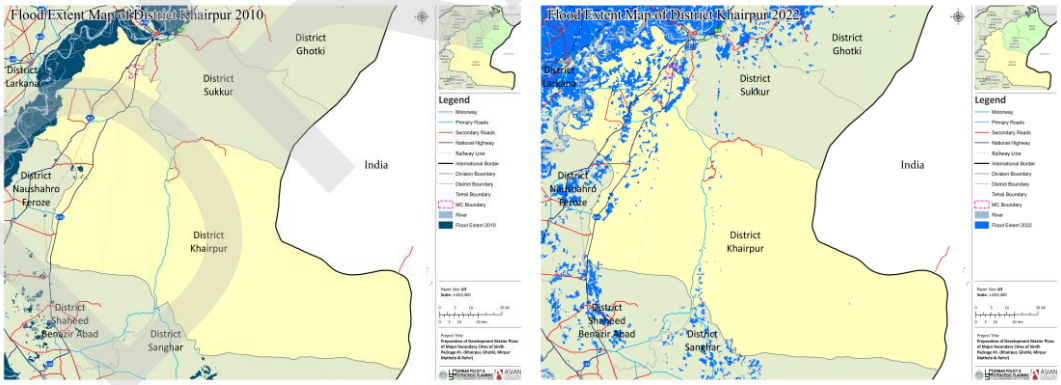


Figure 11-7, Flood Extent Map of District Khairpur with MC Boundaries, 2010, 2022

Source: *The Consultant Team*

Figure 11-7 shows a comparison of flood water extents in the Khairpur district between 2010 and 2022. It can be seen that floodwater spread in the Khairpur district was very minor in 2010 and lies along the boundary of district Khairpur and district Naushahro Feroze. The maps indicate that there is no

[24] *(Flood 2022 in Sindh PREPARED BY PDMA, 2022)*

floodwater within the MC Khairpur boundary in the year 2010 while on the other hand, 20% of the area within the MC Khairpur boundary is covered with floodwater.

The recurring nature of these floods, compounded by siltation of riverbeds, poor maintenance of embankments, and unregulated urban expansion into floodplains, increases the exposure of the population. Informal settlements along water channels are particularly vulnerable, with inadequate housing structures, limited evacuation options, and no insurance coverage against natural calamities.

1. Assessment and Comparison of Damages under Flood (2022 and 2010)

Table 11-2, Flood Damages in District Khairpur

Flood (2010)	Count	Flood (2022)	Count
People Died	25	**People died**	93
People Injured	65	**People injured**	60
Population Affected	384,137	**Animal Deaths**	34,373
Fully Damaged Houses	11,553	**Population Affected**	1,265,477
Partially damaged House	17,470	**Population Displaced**	1,218,177
Villages/Dehs Affected	2,075	**Acres of Crops Damaged**	356,582
Households Affected	62,973	**Fully Damaged Houses**	54,820
Total Affected Area	388,638	**Partially Damaged Houses**	224,346
Crop Area Affected	182,891		

***Source**: Pakistan Emergency Situation Analysis: District Khairpur, 2014, PDMA Sindh 2022*

2. Hydrological Analysis

The hydrological analysis serves to evaluate flood impacts and guide disaster management efforts by identifying areas most affected by inundation and disrupted connectivity. This information is crucial for planning relief and rehabilitation measures. Additionally, it supports long-term urban and regional planning by identifying flood-prone zones that require mitigation strategies, contributing to the development of resilient land use and infrastructure plans.

The analysis was conducted using advanced 2D hydrodynamic modelling in HEC-RAS to accurately assess flood risks and impacts. The methodology incorporated high-resolution terrain data, with a 30-meter Digital Elevation Model (DEM) processed to capture subtle elevation changes critical for flood modelling. The study area was precisely defined using administrative boundaries of District Khairpur, ensuring the analysis aligned with jurisdictional planning needs. The model setup included creating a detailed 2D flow area with variable cell sizing, employing finer resolution in vulnerable urban centers and coarser grids in less critical areas to optimize computational efficiency.

The key hydraulic inputs included boundary conditions representing inflow/outflow points and gridded meteorological data, particularly for the August 2022 flood event that severely impacted the region. The model underwent rigorous calibration and validation against historical flood records and field observations where available. The simulation outputs provided comprehensive flood characteristics including extent, depth variations (from 0.05 feet to over 1 feet), flow velocities, and duration of inundation. These results (as shown in **Figure** 4-5) were visualized through detailed flood maps, with inundated areas clearly marked in blue gradients indicating depth variations, while critical infrastructure networks were overlaid to assess disruption impacts.

The analysis serves dual purposes for both immediate disaster response and long-term resilience planning. The detailed flood maps enable to identify priority areas for relief operations and evacuation planning. For long-term development, the results inform land-use zoning decisions, infrastructure design standards, and mitigation strategies, particularly for protecting vital transportation routes like motorways and primary roads. By incorporating administrative boundaries, the analysis provides actionable insights tailored for both urban and rural planning contexts, supporting the development of comprehensive flood resilience strategies across District Khairpur.

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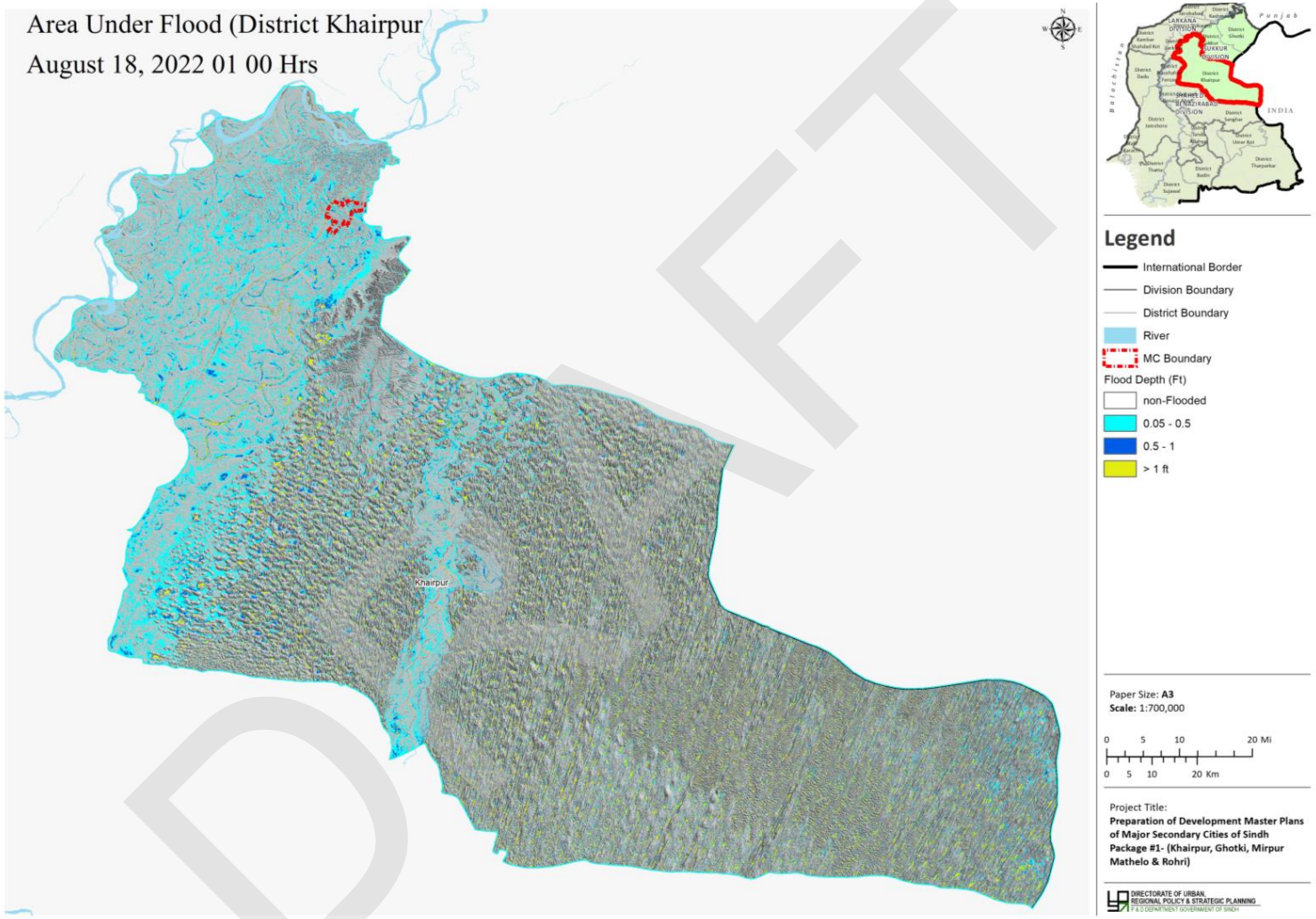


Figure 11-8, Hydrological Analysis – Khairpur District

Source: *The Consultant Team*

11.3.2 Droughts

Khairpur District has faced significant droughts, particularly highlighted by the famine conditions of December 2013 to April 2014, when over 39,000 people and thousands of livestock were affected due to failed monsoon rains and severe shortages of food, fodder, and water. Relief efforts were undertaken by NDMA, PDMA, the Sindh Government, and humanitarian agencies, with medical assistance provided to nearly 4,000 individuals. Despite no official deaths reported by the District Health Officer, malnutrition and hunger rendered 7,835 families vulnerable, especially in desert areas.

Meteorological drought in Khairpur is classified as moderate, with persistent rainfall deficits and increased evaporation rates due to rising temperatures, particularly in areas bordering Jacobabad and Shikarpur. Although the Indus River offers some protection, erratic monsoon patterns have undermined rainfall reliability. In contrast, agricultural drought is more severe, especially in canal-dependent zones like Nara Taluka, where soil moisture depletion and unequal irrigation contribute to extreme drought risk. Other vulnerable areas include Faiz Ganj, Thari Meer Wah, and Kot Diji, which are at risk during prolonged dry spells despite near-normal rainfall. Following maps (**Figure** 11-9) depicts the last five years meteorological and agriculture drought conditions in district Khairpur.

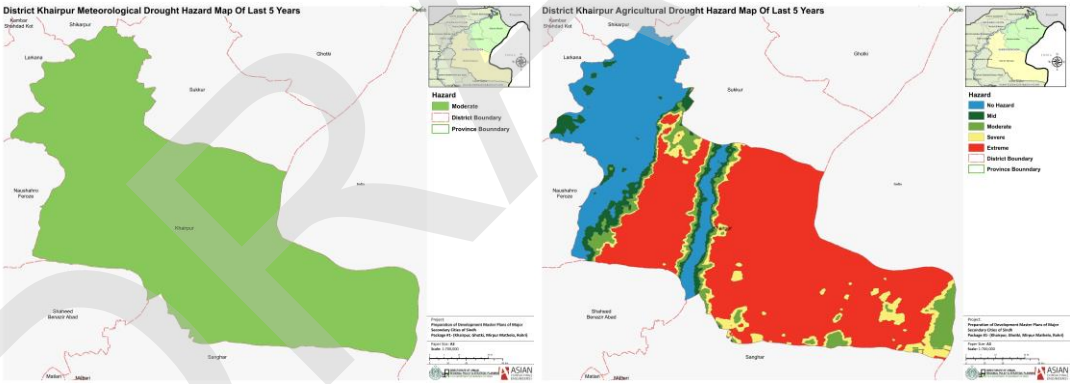


Figure 11-9, Meteorological and Agricultural Drought Hazard Maps of District Khairpur of Last 5 Years

Source: *The Consultant Team*

11.3.3 Heatwave

Khairpur district experiences extremely hot summers with a hot desert climate, where temperatures regularly reach up to 50°C or higher. This intense heat creates serious health risks. The dry heat season typically begins in April and continues until early June, just before the monsoon season arrives. Although monsoon rains in Khairpur are generally light, they bring high humidity, which increases the heat index and exacerbates the discomfort caused by the high temperatures. Historically, Khairpur has faced deadly heatwaves; for example, in 2006, a heatwave claimed four lives and hospitalized ten people, including children. In 2007, temperatures soared to 51°C during a severe

heatwave affecting Khairpur and surrounding areas. More recently, during the 2024 heatwave, temperatures in Khairpur reached around 49.3°C, contributing to one of the hottest periods on record and causing widespread health issues.

According to the Pakistan Meteorological Department (PMD), maximum temperatures in Khairpur and nearby areas have shown a rising trend over the years, with recent daily maximums frequently exceeding 45°C during peak summer months. Historical data indicates that extreme heat events have become more frequent. This warming trend, combined with high humidity during monsoon onset, significantly elevates the heat stress experienced by the population in Khairpur, increasing health risks and socio-economic impacts.

Continued monitoring and proactive planning are essential to safeguard the health and well-being of Khairpur's residents in the face of escalating climate challenges. (**Figure** 11-10) below shows the areas in District Khairpur that experienced the most intense heatwave during the past decades.

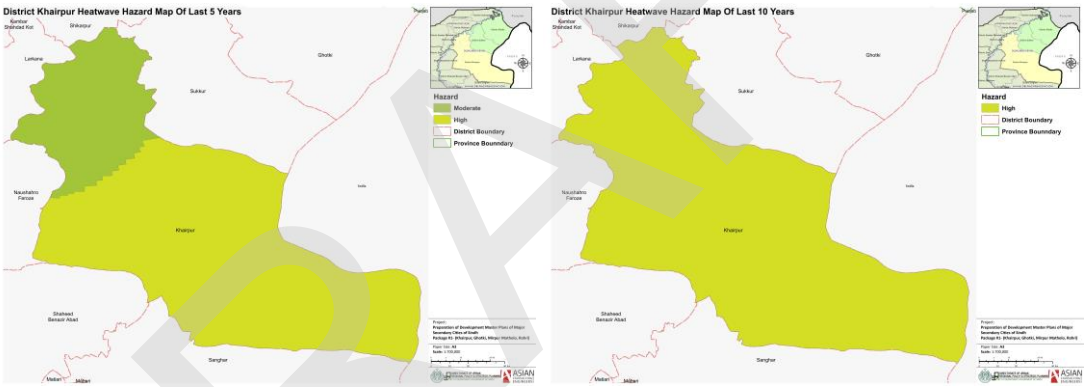


Figure 11-10, Heatwave Map of District Khairpur

Source: *The Consultant Team*

11.3.4 Earthquake

Based on data from the Pakistan Meteorological Department (PMD) and seismic hazard assessments by NDMA and UNDP, Khairpur falls within the "Zone 2A" or "Very Light Hazard Zone" of the Pakistan Seismic Map which means that there will be "moderate to low damage" by earthquakes. While Khairpur itself has not been the epicentre of significant seismic events, the region occasionally experiences mild tremors originating from nearby areas such as Kashmore, Jacobabad, and parts of Balochistan. These tremors typically register below magnitude 4.5 on the Richter scale and have historically caused no notable damage or casualties in Khairpur. Seismic vulnerability maps covering the past 95 years confirm that no major earthquakes have struck the district, underscoring its relatively stable seismic profile. However, given the unpredictable nature of earthquakes and the proximity to more seismically active zones, continuous monitoring and preparedness remain essential to mitigate any future risks.

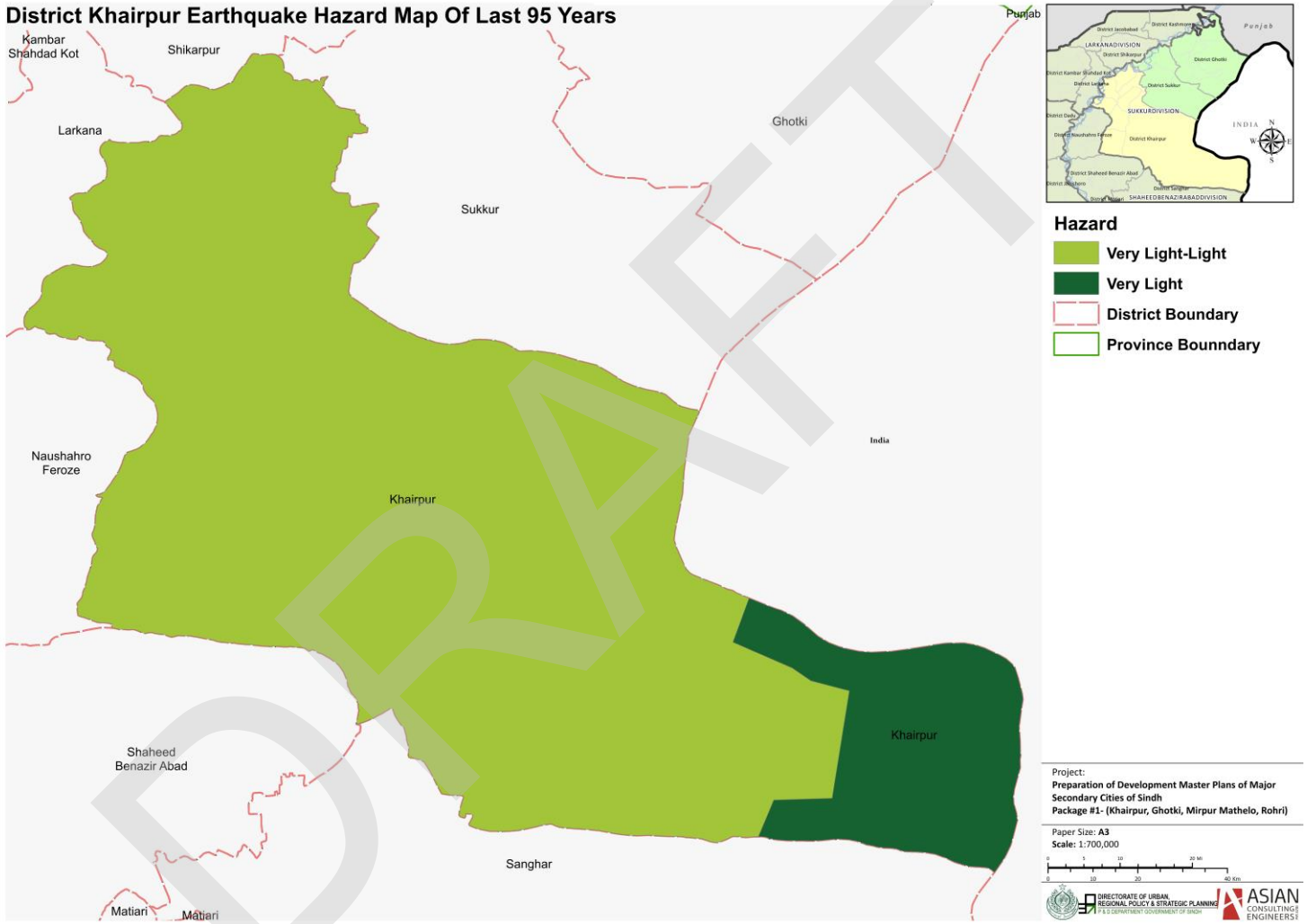


Figure 11-11, District Khairpur Earthquake Hazard Map of Last 95 Years

Source: *The Consultant Team*

11.4 Vulnerability Profile

Vulnerability refers to the magnitude by which communities, infrastructure, services, or specific geographic areas are prone to damage or disruption from the impact of a particular hazard. Vulnerability profiling involves assessing the exposure and sensitivity of these 'elements at risk' to various natural and man-made hazards. It is essential for identifying areas of concern, prioritizing interventions, and formulating effective disaster risk reduction strategies. Key vulnerability factors of disasters include the following and are not limited to these only. These vulnerability factors not only amplify the immediate impacts of disasters but also complicate long-term recovery and resilience-building efforts.

- Social Vulnerability
- Physical and Environmental Vulnerability
- Institutional and Behavioural Vulnerability

11.4.1 Social Vulnerability

The district's social fabric significantly influences its resilience. Specific population groups are disproportionately vulnerable due to factors like age, health, socioeconomic status, and geographic location. These groups require targeted strategies in early warning, evacuation, and relief distribution.

A. Vulnerable Population

In the context of disaster risk, whether earthquakes, floods, or heatwaves, certain population groups in Khairpur are especially vulnerable due to limited mobility, access to resources, or heightened exposure. These individuals often face greater challenges in both responding to and recovering from disasters. Preparedness and response plans must be inclusive and prioritize these groups through targeted awareness, accessible infrastructure, and equitable relief support. The vulnerable populations include:

- Elderly persons
- Persons with disabilities
- Women, especially pregnant and lactating women
- Children, particularly those without guardians
- Low-income households
- Daily-wage labourers and informal sector workers
- Residents of informal settlements or flood-prone areas

These groups should be at the centre of community-based disaster risk reduction efforts to ensure equity, safety, and resilience for all.

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11.4.2 Physical and Environmental Vulnerability

The interaction between human settlements, infrastructure, and the natural environment creates significant physical vulnerabilities

A. Encroachments in Katcha Areas

The unchecked expansion of settlements and agricultural activities along riverbanks has been a major contributor to the severity of recent floods, as seen in Pakistan's 2022 flood disaster. As the encroachment in Katcha Riverine areas significantly reduces river channel capacity and heightens flood risks. Some of the peculiar features of this area are nomadic living style, poverty, low literacy rates and tribal setup, all of which add to the threat to the lives and properties of these people.

B. Illegal Zamindari Bunds (Unauthorized Embankments)

Zamindari bunds are illegally constructed embankments by influential individuals or groups to protect private land from flooding. These unauthorized structures disrupt the natural flow of floodwaters, placing excess pressure on official flood protection bunds. The Irrigation Department is legally mandated to dismantle such structures, but enforcement remains inconsistent.

C. Vulnerable Points on Bunds

Certain locations along protective bunds have been identified as structurally weak or high-risk based on past flood behaviour. These points require reinforced monitoring, timely maintenance, and emergency preparedness to prevent breaches during high-flow conditions.

11.4.3 Institutional and Behavioural Vulnerability

Governance capacity and community behaviour are critical determinants of disaster resilience.

A. Reluctance to Evacuate from Affected Areas

Reluctance to evacuate from affected areas remains a persistent challenge. Social and economic factors, such as attachment to property and lack of trust in authorities along with ongoing tribal rivalries in the district often lead to resistance in evacuation efforts. Residents are hesitant to leave their homes due to fear of property loss and intertribal tensions. Many prefer to relocate only within their tribal groups, complicating camp management and creating logistical challenges during displacement. Additionally, livestock dependency discourages relocation, increasing casualties and complicating emergency response efforts.

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B. Insufficient Disaster Management Funds

Insufficient disaster management funds hinder the ability to prepare for, respond to, and recover from disasters. After the replacement of Local Governments with Commissionerate System in the district, limited financial resources restrict investment in resilient infrastructure, community preparedness programs, and effective emergency response systems, leaving vulnerable populations at greater risk. In case of any disaster, the districts have to take urgent rescue and relief measures including immediate provision of dry & cooked ration, dewatering of the areas, provision of immediate shelter, provision of earthen ways to the low-lying villages etc. All this has to be done before the Provincial Government and other stakeholders actually come into play. Immediate provision of "Disaster Management Funds" on disposal of Deputy Commissioners is the need of the hour.

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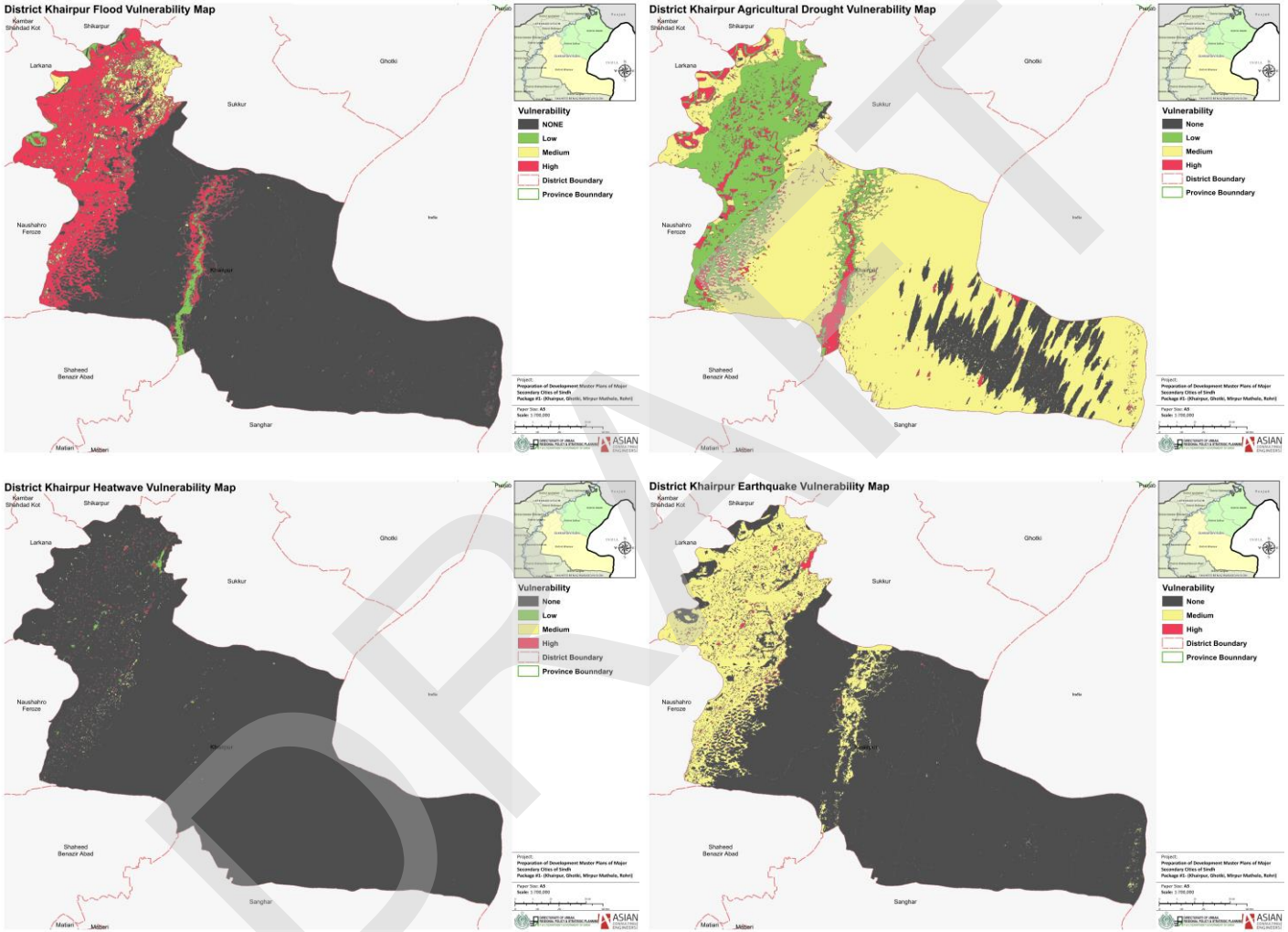


Figure 11-12, Vulnerability Map of District Khairpur

Source: *The Consultant Team*

11.5 Risk Profile

The following table delineates the key natural hazards affecting district Khairpur, highlighting their varying risk level and contributing factors. Riverine flooding poses a risk ranging from low to high, primarily due to seasonal monsoon rains and the district's proximity to the Indus River. Contributing factors include insufficient embankments and the high flow of floodwaters during peak rainfall periods. Urban flooding, though generally of medium to low risk, is increasingly problematic in built-up areas due to poor drainage systems, inadequate urban planning, and rapid urbanization. Meteorological drought presents a medium to extreme risk, driven by the district's semi-arid climate, irregular rainfall, and a lack of adequate water storage infrastructure, significantly affecting agriculture and water availability.

Similarly, agricultural drought ranges from low to extreme, particularly in canal-dependent farming areas where inefficient irrigation and soil moisture depletion persist even in years of average rainfall. Heatwaves, with temperatures reaching up to 50°C, pose a growing threat to public health and livelihoods due to rising temperatures, limited awareness, and a shortage of cooling centers. While earthquakes represent a low risk in terms of frequency, their potential impact remains significant due to the prevalence of older, non-resistant buildings and limited community preparedness. Overall risk profile of Khairpur District is as follows;

Table 11-3, Risk Profile of Khairpur District

Hazard Type	Risk Level	Description	Key Risk Factors
Riverine Flood	Low to High	Seasonal flooding due to monsoon rains and proximity to the Indus River.	Proximity to the Indus River, inadequate embankments, and high flow of floodwater.
Urban Flooding	Medium to Low	Localized flooding in urban areas due to heavy rainfall and poor drainage.	Inadequate urban planning, clogged drainage systems, and rapid urbanization.
Meteorological Drought	Medium to Extreme	Prolonged periods of low rainfall affecting agriculture and water supply.	Semi-arid climate, dependence on rainfall for agriculture, and limited water storage infrastructure.
Agricultural Drought	Low to Extreme		
Heatwave	Low to High	Extended periods of extreme heat impacting health and livelihoods.	Rising temperature reaches up to 50°C, lack of public awareness, and insufficient cooling centres.
Earthquake	Low	Seismic activity causing structural damage and potential loss of life.	Old and weak buildings, lack of earthquake-resistant infrastructure, and limited public preparedness.

Source: *The Consultant Team*

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11.6 Man-Made Hazards

Man-made disasters, particularly fire hazards, pose a significant threat to urban areas in developing regions, including Khairpur City. Fire hazards are unique in that, unlike many natural disasters, they often stem from individual negligence within buildings but can quickly escalate into large-scale urban emergencies. The risk is heightened by inadequate enforcement of safety regulations, use of substandard materials, and limited public awareness of fire prevention measures. However, with proper planning, routine inspections, and community engagement, fire risks can be significantly mitigated.

Another major concern in Khairpur is crowded public areas which are potential targets for terrorist activities due to their accessibility, lack of advanced surveillance systems, and limited security protocols. These vulnerable zones, commonly referred to as Soft Targets and Crowded Places (ST-CPs), include marketplaces, transport hubs, religious sites, educational institutions, public parks, shopping centres, and government offices. Events that draw large crowds—such as political rallies, religious gatherings, and cultural festivals—further increase the risk of mass-casualty incidents. The city's limited capacity for proactive monitoring, emergency preparedness, and crowd control heightens its exposure to such threats. Strengthening urban security measures, including surveillance, controlled entry points, public awareness, and rapid response protocols, is essential to mitigate the risk of terrorism in these high-density areas and ensure public safety.

The current situation reveals a lack of adequate risk assessments, emergency response planning, and protective measures for such high-risk zones, necessitating targeted interventions in urban safety and disaster preparedness planning

11.6.1 Fire Fighting System

A. Existing Situation and Gaps

The firefighting system in Khairpur is critically under-equipped to handle major fire emergency event. It relies on a single, outdated fire station with a limited number of operational vehicles that are poorly maintained and mechanically unreliable. These vehicles also suffer from low water-carrying capacity, reducing their effectiveness during emergencies. Another major issue is the inadequate distribution of water hydrants across the city. In several areas, hydrants are either non-functional or do not exist at all, forcing firefighters to rely on alternative, time-consuming methods to access water during emergencies.

Population density mapping identified high-risk, densely populated neighbourhoods characterized by narrow streets, unplanned layouts, and poor road access all of which hinder firefighting and evacuation efforts. Spatial analysis revealed that the city's only fire station is located 6 to 10 kilometres from various urban edges, further delaying emergency response in distant areas. Although no major fire incidents have been reported in recent years, the current lack of infrastructure and preparedness leaves the city highly vulnerable to potential future disasters.

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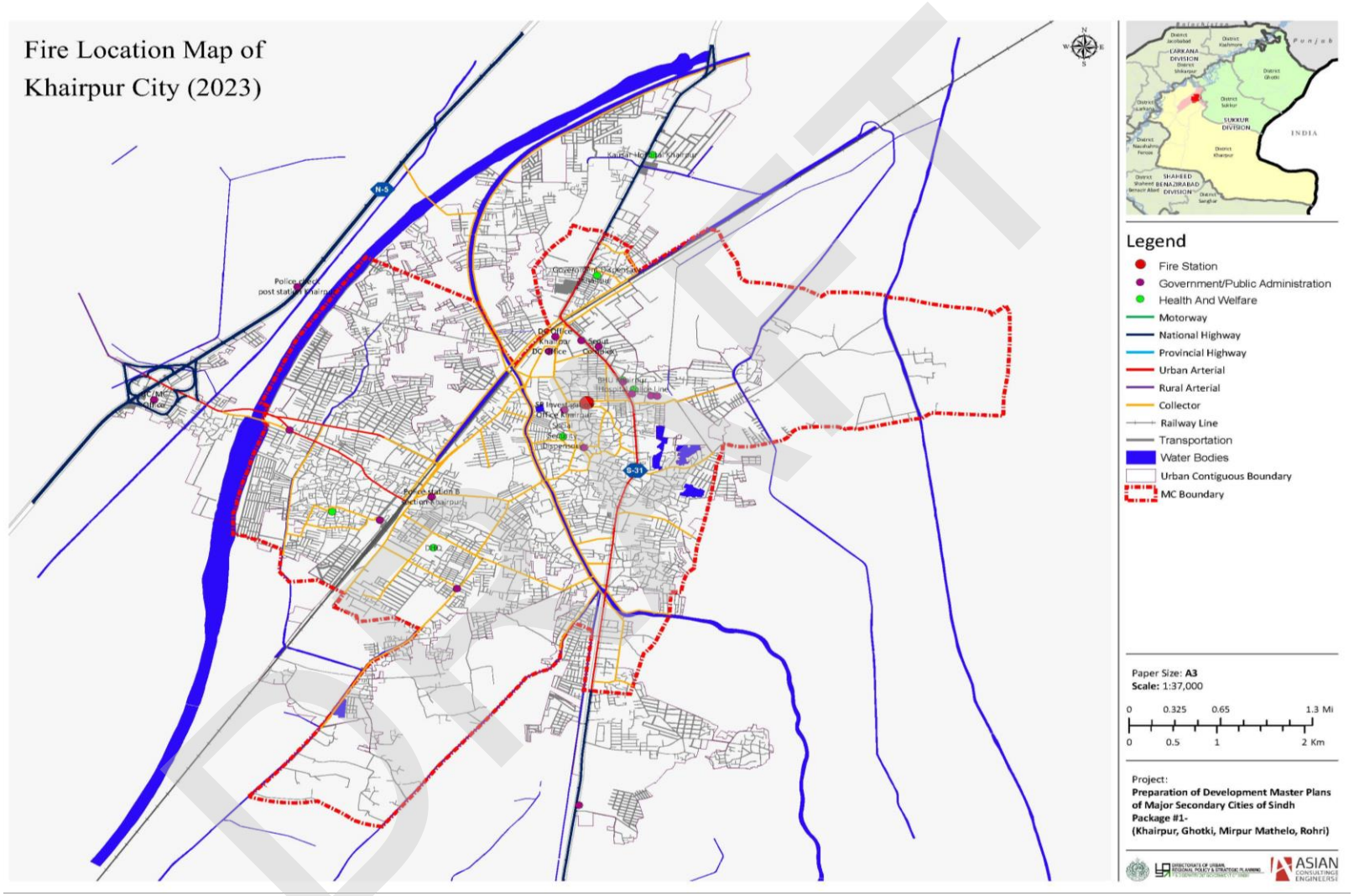


Figure 11-13, Fire Station Location Map of Khairpur City

Source: *The Consultant Team*

B. Need Assessment for 2043

According to the National Reference Manual (NRM) standards; one fire station is required for 100,000 people, having a site area of approximately 2,025 sq. m. or about 4 Kanals. In regards to firefighting station coverage, Disaster Risk Reduction (UNDRR); Sendai Framework for Disaster Risk Reduction (2015 – 2030) and its Words into Action guidelines states that ideally, fire stations should maintain a response coverage radius that enables response times of 3 to 5 minutes in densely populated urban areas and no more than 7 to10 kilometres in broader municipal or rural regions.

In regards to preparedness of multi hazard emergencies, as per UNDRR, there should be at least 2 fire tenders with one at least a high-capacity unit capable of carrying a minimum of 1,500 litters of water. Supporting firefighting equipment such as portable pumps, foam units, breathing apparatus, hose lines, and first aid kits must also be readily accessible. Reliable water sources are critical, and thus, the presence of a well-maintained hydrant network is essential, with hydrants ideally located within 500 meters of high-risk facilities. Where hydrants are not available or are unreliable, alternative sources such as water bowsers, storage tanks or water tansk with pumps should be present to ensure continuity during fire emergencies. The staffing model should support 24/7 operations with shift-based deployments, and staff must be trained not only in firefighting but also in community engagement, emergency evacuation, and hazard-specific response.

In regards to Khairpur, need assessment for firefighting station is calculated as follows;

Table 11-4, Firefighting Station Requirements: A Need-Based Assessment for 2043

Year	Projected Population	Proposed High Density 2043		National Reference Manual (NRM)			
		High Density Residential (%)	Vulnerable Population	One Firefighting Station	One Fire Engine	One Tanker with Pump	Fire Fighting Station Area (sq. m.)
2043	510,921	15%	76,638	0.77 ~ 1	3.07 ~ 3	15	2025

Source: *The Consultant Team, NRM*

The firefighting infrastructure requirement, upgradation and capacity building for Khairpur by the year 2043 have been projected based on the anticipated population growth and high-density development patterns. As the projected population is estimated to reach 510,921 by 2043 with approximately 15% of this population around 76,638 individuals expected to reside in high-density zones and considered particularly vulnerable during fire emergencies.

According to National Reference Manual (NRM), one firefighting station is recommended per 100,000 population. Applying this standard to the vulnerable population yields a requirement of approximately 1 firefighting

station, indicating a strong need for at least one full-fledged facility to adequately serve the area.

Further, as per the NRM standards:

- One fire engine is required for every 25,000 - 75,000 population, calculating the threshold i.e., 1/25,000 population resulting in a need for approximately 3.07 ~ 3 fire engines.
- One water tanker equipped with a pump is needed for every 5,000 -25,000 population, calculating the threshold i.e., 1/5,000, translating to a requirement of 15 such units to be deployed in areas where water is sufficiently available.
- In terms of land allocation, a minimum area of 2,025 square meters or ~ 4 Kanals is recommended for establishing a standard firefighting facility that can accommodate necessary equipment and operations. These projections emphasize the urgent need for infrastructure enhancement to ensure fire safety in Khairpur's future urban fabric.

11.6.2 Assessment of Crowded Places

Soft Targets and Crowded Places (ST-CPs) are locations that are easily accessible to large numbers of people and that have limited security or protective measures in place making them vulnerable to attack. ST-CPs can include, but are not limited to, schools, sports venues, transportation systems or hubs, shopping venues, restaurants, hotels, places of worship, tourist attractions, theatres, and civic spaces. These places do not have to be buildings and can include open spaces such as parks and pedestrian malls. ST-CPs will not necessarily be crowded at all times crowd densities may vary between day and night, by season, and may be temporary, as in the case of sporting events, festivals, or other special events.

A. Crowded Places in Khairpur

Mostly the sensitive places in Khairpur city are religious places including Eid Gahs, Imam Bargahs, Temples, Church and Gurdwara's, other places may include but not limited to Faiz Mahal and transportation terminal which need special security measures to make them safe for the general public. Areas with significant Shi'a populations host religious processions and other commemorations. Such processions typically follow traditional routes to and from Shi'a Imam Bargahs and often pass through crowded commercial areas. Larger processions prompt localized traffic and business disruptions. Mostly the incidents occur due to the tribal conflicts resulting in closure of shops, offices, and commercial areas and to make the situation under control a heavy deployment of Rangers and police has been observed in various areas of Khairpur[25]. Security likely to be particularly tight near Imam Bargahs and Shi'a religious procession routes.

[25] https://www.usip.org/sites/default/files/PW104-Conflict-Dynamics-in-Sindh-Final.pdf

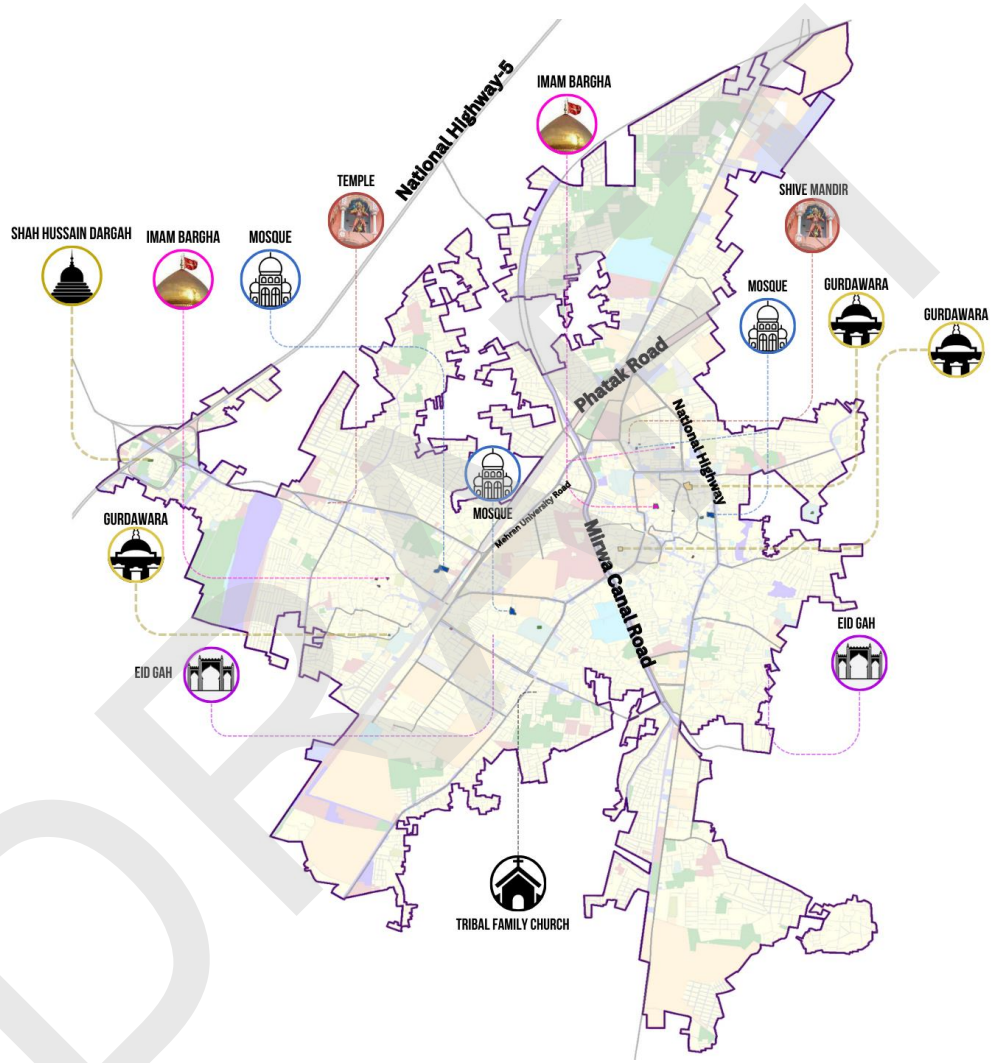


Figure 11-14, Identification of Major Crowded Places

Source: *Land use Survey*

Further, the possible terrorist Intensity places has been identified in Khairpur City on the basis of Crowd and most visiting places by the Public. The places are classified according to the land uses which are potential crowd pulling places.

Table 11-5, Potential Terrorist Threat Zones

Sr. No.	Land Use	Terrorist Threat
1	Education	Secondary Schools/College/ University
2	Health	BHU/Hospitals/Medical Collages
3	Commercial	CBD/Mandi/shopping mall
4	Religious	Eid Gah / Shrines/Minority Religious Places/Imam Barghas
5	Government Offices	District Court/DCO Office/SSP Office/District Jail/Police Head Quarter/LEA
6	Recreational	Tourism Places
7	Transportation	Bus Stop/Railway Station/Airport

Source: *The Consultant Team*

B. Identification of Potential Stakeholders

Preventing attacks against ST-CPs and reducing impacts of attacks that do occur is a shared mission among many stakeholders. Law enforcement agencies, National Counter Terrorism Authority (NACTA), venue owners, facility managers and general public are key stakeholders in implementing security measures. Federal Ministries/Departments, Federal Law Enforcement/Intelligence Agencies, Provincial Ministries/Departments, Social Welfare Departments/Ministries, Police, Criminal Investigation Department, Counter Terrorism Department, Bomb Disposal Units and healthcare providers are crucial departments in responding to emergencies in crowded spaces.

Government agencies, regulatory bodies, and community organizations collaborate to establish safety regulations, conduct risk assessments, and promote public awareness campaigns. Effective collaboration and coordination among these stakeholders are essential for ensuring the safety and security of individuals in crowded spaces.

C. Responsibilities of Stakeholders

Implementation of protective security measures and reducing the vulnerability of crowded places to terrorist attack was not just a job for the Government (Federal / Provincial / Division / District) and the police alone. To be most effective, this work requires engagement from a range of local partners, including local authorities and businesses, in order to identify vulnerable sites and prioritize work to reduce those vulnerabilities.

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D. NACTA's Specific Coordination Measures for Enhancing National Efficiency Against Terrorism/Extremism

NACTA has played a role in designing and executing SOPs, security plans and programs to enhance the security of ST-CPs which is elaborated in **Figure** 11-15. Recent changes in the threat landscape and trends in global and domestic incidents call for a renewed level of focus on this problem.

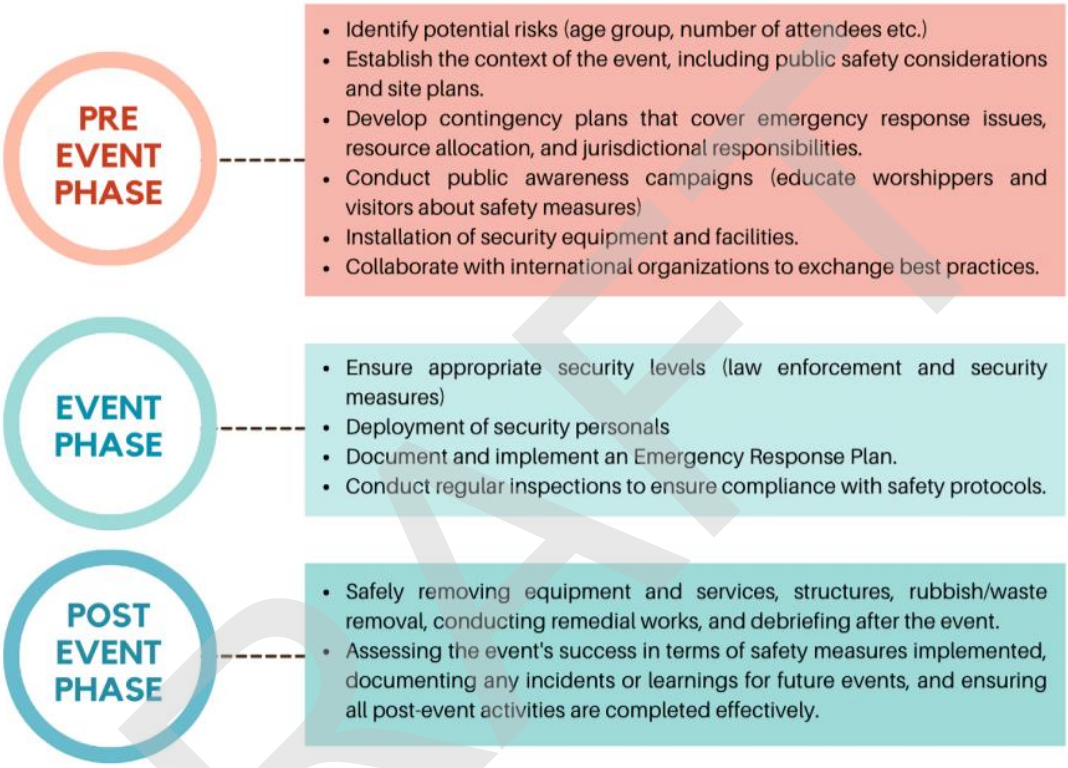


Figure 11-15, Sensitive Areas Security Primary Planning Phases

Source: *The Consultant Team*

11.7 Institutional Framework and Key Challenges

11.7.1 Hierarchical Institutional Structure

The disaster management system in Ghotki operates on a four-tiered model for seamless policy-making, coordination, and implementation:

Authority Level	Chairperson / Lead	Primary Role & Function
Provincial Disaster Management Commission (PDMC)	Chief Minister	**Policy-Making Body** • Lays down provincial DRM policy • Approves plans • Oversees integration of DRR into development planning
Provincial Disaster Management	Minister, Rehabilitation	**Provincial Implementing & Coordinating Agency**

Authority Level	Chairperson / Lead	Primary Role & Function
Authority (PDMA)	Dept.	• Develops strategies and coordinates response • Mobilizes resources • Supervises all DDMAs in Sindh • Manages large-scale disasters
District Disaster Management Authority (DDMA)	Deputy Commissioner	**District-Level Coordination & Implementation Focal Point** • Prepares and implements the District Disaster Management Plan • Leads emergency response • Manages the District Emergency Operation Centre (DEOC)
Taluka Disaster Management Committee (TDMC)	Assistant Commissioner	**Frontline Implementation at Taluka Level** • Bridges DDMA and communities • Ensures local implementation of plans • Conducts local risk assessments • Manages shelter and evacuation
Union Council Disaster Management Committee (UCDMC)	UC Administrator	**First Responder & Community Mobilization** • Acts as the first point of contact during a disaster • Mobilizes community volunteers • Reports ground situations • Assists in relief distribution

Source: *PDMA, Sindh*

11.7.2 Institutional Framework and Coordination Mechanisms

An effective disaster management response hinges on seamless coordination between all stakeholders. While the National Disaster Management Act (2010) and Sindh Local Government Act (2013) outline the roles of various institutions, a clear operational protocol is essential to avoid duplication of efforts, ensure accountability, and facilitate a swift, unified response.

The following matrix details the coordination protocols for critical phases of disaster management. The structure ensures that for every action, one entity is clearly in charge (Lead Agency), other entities know their specific support duties, and a pathway exists for resolving issues or acquiring additional resources (Escalation Mechanism).

Table 11-6, Disaster Management Coordination Protocols

Phase / Activity	Lead Agency	Key Support Agencies	Support Functions	Escalation Mechanism
Pre-Disaster (Preparedness & Planning)				
Risk Assessment & Early Warning	Pakistan Meteorological Department (PMD) / Irrigation Dept (for flood levels)	• DDMA • PDMA • Local Governments	• DDMA disseminates warnings to TDMCs/UCDMCs and public. • Local Govt. activate local alert systems (sirens, mosque speakers).	If warning indicates a major disaster (e.g., Very High Flood), DDMA immediately escalates to PDMA to activate provincial resources.
Community Preparedness & Drills	District Disaster Management Authority (DDMA)	• TDMCs/UCDMCs • Police Dept • Health Dept • NGOs (e.g., Red Crescent)	• TDMCs/UCDMCs mobilize community volunteers and identify evacuation routes. • Health department provide first aid training. • Police manage traffic and security during drills.	If community participation is low, UCDMC -> TDMC -> DDMA will organize awareness campaigns with support from Social Welfare.
Pre-positioning of Relief Stocks	Provincial Disaster Management Authority (PDMA)	• DDMA • Red Crescent	• DDMA identifies secure storage locations at taluka level.	If stocks are insufficient, DDMA submits a formal request to PDMA for replenishment.
During-Disaster (Response)				
Activation of Emergency Operations	District Disaster Management Authority (DDMA)	• All DDMA member departments • Armed Forces (if required)	• DDMO chairs the District Emergency Operation Centre (DEOC). • Police ensures law and order. • Health department sets up medical camps. • Irrigation department provides real-time river	If the disaster scale exceeds district capacity, the DDMA Chairperson (Deputy Commissioner) formally requests PDMA and NDMA for immediate assistance, including armed forces.

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Phase / Activity	Lead Agency	Key Support Agencies	Support Functions	Escalation Mechanism
			data.	
Search and Rescue	Police / Rescue 1122	• Fire Brigade • Community Volunteers (via UCDMC) • Armed Forces Engineers	• Fire Brigade provides technical rescue from collapsed structures. • Community volunteers guide rescuers to affected areas. • Armed forces provide boats and helicopters for flood rescue.	If specialized equipment or manpower is needed, Police/ Rescue 1122 -> DDMA -> PDMA to mobilize provincial/federal resources.
Evacuation	District Administration (Revenue Dept)	• Police • Transport Dept • TDMCs/UCDMCs • Health Dept	• Police department secures evacuation routes and manages traffic. • Transport department arranges buses and trucks. • UCDMCs guide people to assembly points. • The health department is conducting screenings for evacuees at shelters.	If populations are reluctant to evacuate, local elders and UCDMC members lead persuasion efforts, supported by Police.
Shelter Management	Local Government Department	• Social Welfare Dept • Health Dept • Education Dept (for school buildings) • NGOs (e.g., UNHCR, SRSP)	• Social Welfare department register affected individuals and manages distribution of non-food items. • Health department ensures sanitation, vaccination, and medical care in camps. • NGOs supplement government efforts in camp	If shelter conditions deteriorate (disease outbreak, overcrowding), Camp Manager -> DDMA -> PDMA for additional resources and intervention.

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Phase / Activity	Lead Agency	Key Support Agencies	Support Functions	Escalation Mechanism
			management.	
Post-Disaster (Recovery & Rehabilitation)				
Damage and Needs Assessment (DANA)	District Disaster Management Authority (DDMA)	• All Line Departments (PHE, Irrigation, Education, Health, etc.) • Revenue Dept	• Each line department assesses damage to its own infrastructure (schools, clinics, roads). • Revenue Dept assesses crop and private property damage.	DDMA consolidates all reports and submits a unified DANA to PDMA within 72 hours for resource allocation and funding.
Restoration of Critical Infrastructure	Respective Line Department (e.g., PHE for water, Works & Services for roads)	• Local Government • DDMA	• All line departments execute repairs. • DDMA coordinates and prioritizes based on damages and needs. • Local Govt provides local labor and support.	If a department lacks capacity/funds, it reports to DDMA, which escalates the issue to the relevant Provincial Secretary via PDMA.
Livelihoods Recovery	Agriculture / Livestock Dept	• Social Welfare • Fisheries Dept • Banks (for soft loans)	• Agriculture department distributes seeds and fertilizers. • Livestock department provides veterinary services and fodder. • Social Welfare department implements cash-for-work programs.	If recovery is slow, DDMA coordinates with PDMA to link programs with federal/ UN agency initiatives.

Source: *PDMA, Sindh*

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11.7.3 Key Challenges in addressing Natural and Man-Made Disasters

- Weak embankments and illegal Zamindari bunds worsen flood risks.
- Limited cooling centres, urban form and green plantation to reduce heatwave impacts in the city
- Weak enforcement of zoning laws for flood-prone areas
- Reluctance of community to evacuate due to socio-economic factors.
- Absence of sustainable groundwater recharge strategies and water reuse systems.
- Clogged drains due to garbage disposal exacerbate urban flooding.
- Poor Rainwater Harvesting Infrastructure; Minimal use of rooftop or community-based harvesting systems in urban planning.
- Insufficient disaster management funds and coordination.
- Lack of enforcement of building codes and fire safety regulations in residential and commercial areas.
- Inadequate fire-fighting infrastructure (fire stations, hydrants, extinguishers, alarms).
- Poor emergency access due to narrow roads, encroachments, and unplanned urban development.
- Shortage of trained fire personnel and delayed response times during emergencies.
- Minimal security measures at public spaces such as markets, religious sites, and transport hubs.
- Limited surveillance systems (e.g., CCTV coverage, monitoring)
- Unregulated gatherings and lack of crowd management protocols during events.
- Inadequate coordination between law enforcement and emergency services

11.7.4 Key Stakeholders and their Role in Disaster Management

Following are the significant disaster management activities that the lined department, local administration, institution and other district stakeholders are expected to execute at three different stages known as pre, during and post disaster management. Following table depicts the overall role of various stakeholders including District Disaster Management Authority (DDMA), civil defense, education department, finance department, health department, irrigation department, information department, Pakistan Meteorological Department (PMD), police department, revenue department, armed forces, social welfare and community development and NGOs / INGOs in different stages for disaster management;

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Table 11-7, Proposed Key Roles of Stakeholders for Disaster Management in District Khairpur

Pre-Disaster	During-Disaster	Post-Disaster
District Disaster Management Authority (DDMA)		
Close coordination with PDMA and other relevant stakeholders	Mobilization of man and material resources	Coordination with TDMC and line departments for need and damage assessment
Risk assessment and identification of disaster-prone areas	For rescue and evacuation of people, provide and manage temporary shelter and life restoration equipment in disaster affected regions	Need and damage assessment reporting to PDMA
Aware and sensitize public and private departments on main streaming disaster risk reduction in developing planning	Coordinate with TDMC and line departments	Ensure rehabilitation on Build Back Better principle
Coordinate meeting and engage TDMC for preparation of anticipated disasters	The DDMA shall lead the evacuation of people to safer places with the assistance of PDMA. DDMA shall also ensure safety, security, supply chain, life commodities and management of relief camps	
Ensure readiness of equipment and inventory	Only authorized officials of DDMA shall brief media on disaster situation and the response activities.	
Disseminate disaster alerts to concerned TDMC with action plans for forecastable disasters		
Ensure availability of relevant staff before anticipated disaster		
Advise concerned departments on removal of congestion from water ways before monsoon and flooding period		

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Pre-Disaster	During-Disaster	Post-Disaster
Ensure availability and functioning of district emergency operation centre		
Arrange emergency response exercises and drills along with volunteer groups, social welfare and civil defense on various disaster scenarios		
Civil Defense		
Assign representatives for DDMA to participate in meetings	Fire fighting	Assist in rehabilitation process if required
Information sharing regarding capacities and needs of Civil Defense department regarding disaster risk management	Rescue and evacuation	
Capacity building of Civil Defense department regarding disaster risk management	Assign volunteers in coordination with PDMA and DDMA	
Information sharing regarding technical and personnel expertise with DDMA	Communicate to DEOC about details of all activities	
Conduct trainings for Volunteers regarding Rescue and other relevant expertise in collaboration with Health department and PDMA	Communicate to DEOC any additional resources required for performing the above tasks	
Create awareness regarding rescue, evacuation and first aid	Facilitate line departments as per demand in disaster response	
Effectively establish, train and systemize volunteer's initiatives in collaboration with education department / institutions		
Education Department		

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Pre-Disaster	During-Disaster	Post-Disaster
Assign representatives for DDMA and participate in meetings	Mobilize human resources for intervention during disaster	Assessment of damages occurred to educational institutes
Information sharing regarding capacities and needs of Education department regarding disaster risk management	Inform schools situated in high-risk areas about hazard and hazard forecast	Provide assistance to teachers, students and other staff who are victimized by disasters (lack of food, shelter, etc.)
Teachers and students are informed about the disaster-prone areas of the district	Assist in arrangement of relief and shelter camps in educational institutes for the disaster	Rehabilitation and reconstruction of affected educational facilities
Teachers and students are informed of their responsibilities to take care of materials and documents to safe places during disaster	Facilitate Health department and other relevant entities in arranging medical camps, blood donations and provision of medical aid during disaster and emergencies	Facilitate institutions / NGOs / INGOs which focus on rehabilitation of educational facilities
Facilitate and collaborate with PDMA in preparation of disaster management curriculum		
Collaborate with PDMA and DDMA in synergizing volunteers		
Finance Department		
Regular coordination with PDMA	Provide funds to PDMA and other line departments for procurement of material and equipment required for emergency response	Get statistical data regarding actual damage and recovery needs from all line departments
Allocate budget on contingency basis, to handle any emergency situations		Provide funds for execution of rehabilitation process
Facilitate other departments in planning and meeting their financial needs		
Health Department		

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Pre-Disaster	During-Disaster	Post-Disaster
Assign representatives for DDMA, and participate in meetings	Provide emergency treatment for the seriously injured	Conduct disaster impact assessment on health situation
Information sharing regarding capacities and needs of Health department regarding disaster risk management	Ensure emergency supplies of medicines and first-aid	Prepare plan for the following year along with reports and submit to PDMA and concerned department.
Build capacity of health department regarding disaster risk management and preventive health care especially in disaster prone areas	Supervise food, water supplies, sanitation and disposal of waste	Medical camps and vaccination
Monitor the general health situation, e.g., monitor outbreak of diseases	Assess and co-ordinate provision of ambulances and hospitals where they could be sent (public and private);	Rehabilitation of health infrastructure affected during disaster
Provide specific information required regarding precautions for epidemics	Provide special information required regarding precautions for epidemics	Preparation of impact assessment surveys covering strengths and weaknesses of interventions
Establish a health mobile team in district and taluka headquarter hospital	Set-up an information Centre to organize sharing of information for public information purposes	
Set-up an information Centre to organize sharing of information for public information purposes	Conduct disaster impact assessment on health	
Prepare first aid kits, medicines, water test kits, chloramines and anti-snake venom serum.		
Collaboration with relevant organizations / partner NGOs for participation and support through technical resources		
Up-gradation and smooth functioning of hospitals, BHUs, equipped with required staff, medicines and equipment		

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Pre-Disaster	During-Disaster	Post-Disaster
Database and linkages with ambulance services/blood banks		
Health and hygiene awareness and education		
Ensure proper disposal of hospital waste		
Irrigation Department		
Inspection and identification of vulnerable embankments	Ensure 24/7 vigilance of vulnerable embankments	Conduct assessment of damages and needs and report to PDMA through DEOC
Monitoring and dissemination of river water levels	Measure and report flood water inundation levels to DDMA and PDMA	Restore and repair damaged irrigation systems
Implementation of SOPs defined by Bund Manual	Ensure to drain/de-water from agriculture fields and its safe conveyance to minimize losses	Prepare overall report of the department regarding intervention and disseminate to PDMA
Ensure readiness of equipment and machinery before monsoon and flooding season	Coordinate with PDMA and DDMA during entire disaster event for execution of on-demand action plans	
Monitor and disseminate flood level information to DDMA and PDMA		
Initiate necessary embankments reinforcing interventions for vulnerable embankments		
Initiate interventions for river training where necessary		
Introduce and ensure water harvesting and modern water management interventions in likely drought affected areas		
Ensure safety and compactness of irrigation channels, canals, branches, etc. before start of monsoon season to avoid breaches in irrigation		

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Pre-Disaster	During-Disaster	Post-Disaster
system during heavy rains		
Ensure removal of congestion from storm water and draining channels before monsoon		
Information Department		
Close coordination and liaison with PDMA and DDMA	Coordination with PDMA and DDMA for announcement of warnings and updates on disasters	Focus on problems being faced by the people of the affected area
During monsoon, flooding season and forecastable hazards issuance of press releases regarding hazards and preparedness plans of the government	Publication of bulletins on government actions, facilities, relief and rescue efforts	Publish, broadcast /telecast programs highlighting strengths, weaknesses and scams in disaster response activities
Issue and publish disaster alerts on appropriate media forums	Publication of camp management and relief distribution announcements	Publish, broadcast /telecast programs highlighting government initiatives and collective response of NGOs, INGOs and other departments for relief and rehabilitation
Coverage and publication of government initiatives on disaster risk reduction and management	Publication of safety measures during disasters to minimize disaster domino effects	
Ensure media coverage and publication of PDMA and DDMA meetings for pre disaster preparations	Communicate voice of affectees to concerned departments	
Pakistan Meteorological Department (PMD)		
Update and upgrade forecast equipment	Monitoring of flood waters, river flows and sharing of information with PDMA	Technical assistance in rescue and rehabilitation process
Timely and authentic forecast of rains, windstorms and other forecastable hazards	Forecasting for any confluencing disaster	

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Pre-Disaster	During-Disaster	Post-Disaster
Timely transfer of information regarding abnormal weather conditions to PDMA	Issuance of precautionary measures to avoid domino effects of disaster	
Police Department		
Coordinate with the DDMA in the pre-disaster planning	Co-ordinate with DEOC	Assist in relief and rehabilitation process
Participate in DDMA meetings	Assistance in shifting of rescued/affected people to relief camps and hospitals	
Capacity building of Police department regarding disaster risk management	Provide protection and easy access to rescue and relief personnel/vehicles	
Information dissemination through 15 helpline service to local residents	Maintain law and order	
Prepare team for emergency intervention	Provide warning / instruction to travellers	
	Divert traffic on alternate routes as and when necessary	
	Ensure security to workers of NGOs and INGOS who perform duties for disaster response	
	Ensure safety and security of relief goods and maintain discipline during relief distribution process	
	Provide security in Relief Camps	
Revenue Department		
Assign representatives for DDMA, and participate in meetings	Coordination with the DEOC	Allocation of funds for recovery and rehabilitation process
Information sharing regarding capacities and needs of Revenue department regarding disaster risk management	Establish relief distribution centres	Assessment of damage of industry/business, crops and livestock and settlement of applicable

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Pre-Disaster	During-Disaster	Post-Disaster
Capacity building of Revenue department regarding disaster risk management	Accept relief donations and relief support	
Assessment of high prone areas and estimation of possible damage and needs for recovery in case of emergency	Timely release of funds	
Arrangement of financial resources		
Facilitate getting tax exemptions to institutions/NGOs/INGOs focus on disaster risk		
Armed Forces		
Coordinate with the DDMA in the pre-disaster planning	Maintain liaison with the DEOC for vital inputs during response	Cooperate and coordinate with district authorities
Prepare necessary equipment, labor, transportation and other materials for emergency interventions	Collect information and warn appropriate Army units for engagement in safety, rescue and evacuation activities	Assist in rehabilitation process if required
Provide training to soldiers and determine the role of soldiers who are stationed in flood	Establish communication infrastructure and supplement the civil communication set-up if required	
Assist in evacuation of people to safe places	Coordinate all military activity required by the civil administration	
	Provision of medical care with the help of the medical teams, including treatment at the nearest armed forces hospital	
	Transportation of relief material	
	Provision of logistic back-up (aircrafts, helicopters, boats)	
	Assist in establishment of Relief Camps	
	Assist in evacuation of people to safe	

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Pre-Disaster	During-Disaster	Post-Disaster
	places during the disaster	
	Installation of temporary Bridges, Bunds	
	Maintain liaison with the DEOC for vital inputs during response	
	Collect information and warn appropriate Army units for engagement in safety, rescue and evacuation activities	
	Establish communication infrastructure and supplement the civil communication set-up if required	
	Coordinate all military activity required by the civil administration	
Social Welfare and Community Development		
Coordination with NGOs and civil society organizations working for disaster risk management	Provide information on the situation of the disaster to the DEOC	Monitor and follow up the status of the extremely vulnerable people
Empower the extremely vulnerable people emphasizing women and children through public	Coordinate all NGOs / INGOs and civil society organizations working during the emergency response	Assist and facilitate Damage and Needs Assessment teams from NGOs
Awareness involving respective departments for various fields such as Education, Health etc.	Monitor progress of relief operations in the affected areas	Conduct impact assessment studies and analysis of strengths and weaknesses of stakeholders and disseminate learning to PDMA, DDMA and other concerned institutions
	In coordination with PDMA, Health, Revenue and other line departments, ensure delivery of relief to most vulnerable	Facilitate institutions / NGOs/ INGOs which focus on rehabilitation activities

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Pre-Disaster	During-Disaster	Post-Disaster
	segments of society such as children, orphans, widows, destitute	
	Assist and facilitate Damage and Needs Assessment teams from NGOs	
	Share human resources with DDMA	
NGOs / INGOs		
Facilitate PDMA and DDMA for capacity building regarding disaster risk management	Collaborate and facilitate in relief operations	Collaborate and facilitate in rehabilitation activities
Capacity building of community groups regarding disaster risk management	Incorporate local and international expertise in disaster response	Incorporate local and international expertise in rehabilitation activities
Linkages with concerned departments and institutions for providing technical and financial resources regarding diverse sectors related to disaster management	Facilitate establishment of temporary shelters and camps	Facilitate overall rehabilitation in collaboration with concerned departments
Resource mobilization at local and international level	Facilitate in overall disaster response in collaboration with concerned departments	Impact assessment studies and sharing findings with PDMA, DDMA, local and international partners
	Regular updates and alerts to local and international partners	Linkages with partners for sustainable resources mobilization
	Utilization of existing resources and further mobilization at local and international level	
	Assessment of losses using sphere standards	

Source: *NDMA*

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11.8 Disaster Management Plan

Multi-hazard vulnerability Risk Assessment of Khairpur district reveals that the district is relatively safe in terms of natural disasters. The pertinent hazards to district are hydro-meteorological hazards including drought and riverine flood with the potential to cause urban flooding. The risk of geophysical hazards is low in the district. In modern technological era, hydro-meteorological hazards can be precisely forecasted and action can be taken well in time to minimize damages and losses. In other words, the vulnerabilities and risks are manageable and losses and damages can be minimized through adoption of best management practices and mobilization of resources.

These guidelines introduce best practices which can be adopted to manage risk of natural disasters in the district.

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Table 11-8, Best Practices to Manage Risk of Natural Disasters in District Khairpur

Disaster	Mitigation Measures	Responsible Agency
Riverine Flood	• Identify and reinforce vulnerable sections of river embankments based on pre-monsoon surveys and satellite imagery. • Conduct pre-monsoon clearance of stormwater drains and natural waterways to prevent urban flooding. • Activate a multi-channel public early warning system (SMS, FM Radio, Mosque announcements) for communities in low-lying areas. • Pre-position emergency stocks (tents, boats, medical kits) at Taluka level, especially in 13 flood-prone UCs.	DDMA, Irrigation Department, Local Government, PDMA
Earthquake	• Identify and retrofit old and vulnerable public buildings (e.g., schools, hospitals) in urban settings. • Enforce building codes for all new construction projects. • Conduct annual earthquake safety drills in schools and major public institutions.	Local Government, Works & Services Department, Health Department, DDMA, Civil Defense
Heatwave	• Issue public health warnings and precautionary advisories via SMS and local media when temperatures exceed 45°C. • Establish temporary cooling centers in public buildings (schools, community halls) in urban areas. • Launch public awareness campaigns on heatstroke prevention and water conservation. • Promote tree plantation to reduce urban heat island effect.	Health Department, Information Department, PMD, Local Government, NGOs
Drought	• Promote and distribute drought-resistant seed varieties to farmers. • Monitor groundwater levels and promote efficient irrigation systems (drip irrigation, laser leveling). • Establish and manage community seed banks at UC level to ensure food security. • Introduce water harvesting and modern water management practices in drought-prone areas.	Agriculture Department, Irrigation Department, Social Welfare, P&D Department, Community Organizations

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Disaster	Mitigation Measures	Responsible Agency
General Multi-Hazard	• Integrate DRR into development planning and projects. • Strengthen community-based volunteer networks and conduct regular training. • Maintain and update contact databases of key stakeholders and vulnerable communities.	PDMA, DDMA, TDMC, UCDMC, NGOs

Source: *MHVRA Informed Disaster Management Plan, Khairpur District (2023–2032)*

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11.8.1 Urban Resilience and Sectoral Roles

Building on the disaster management guidelines, this section outlines a strategic framework for embedding resilience into the urban fabric and development planning of Khairpur District. The objective is to shift from reactive disaster response to proactive risk reduction by addressing sectoral vulnerabilities through clearly defined roles and accountable actions. The following table presents the core objectives for adaptation and urban resilience, each linked to specific, actionable measures and the primary stakeholders responsible for implementation. This ensures that disaster risk reduction is not a standalone activity but is mainstreamed into the core functions of all relevant government departments and community institutions.

Table 11-9, Objectives and Action Plan for Adaptation & Urban Resilience

Objective	Sub- Objectives	Responsible Stakeholders
Infrastructure	Climate-adaptive public and critical infrastructure	MC, PHED, SID
	Stormwater drainage to reduce urban flooding	
	Erosion protection of waterfronts and canal banks	
	Low-carbon transport systems with redundancy for post-disaster mobility	
	Cooler walkways and public spaces to mitigate heatwaves	
Water, Sanitation, and Waste	Functional sanitation and drainage to prevent disease outbreaks after floods	MC, SIDA
	Safe waste disposal to avoid contamination	
	Reverse osmosis & sustainable groundwater use to combat water logging & drought	
	Plastics recycling and sewage treatment to reduce environmental hazards	
Agriculture, Irrigation, Livestock & Fisheries	Promote drought- and flood-tolerant crops	AGED, SIDA, Fisheries Dept.
	Improve irrigation efficiency & protect from salinity/waterlogging	
	Research climate-resilient seeds and fishery techniques	
	Market linkages to restore livelihoods after disaster shocks	
Human Health & Well-Being	Health facilities resilient to floods	HLD, MC, MoCC
	Awareness campaigns on heatstroke &	

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Objective	Sub- Objectives	Responsible Stakeholders
	vector-borne disease	
	Reduced disaster mortality and disease spread	
Governance & Partnerships	Community-based disaster committees (CBDRM)	DDMA, GOS, MC, NGOs
	Enhanced inter-agency coordination	
	Women, youth & vulnerable group empowerment in response teams	
Food Security	Flood and salinity control projects	Food Dept., MC, NGOs
	Emergency food distribution points	
	Livelihood diversification to reduce disaster vulnerability	
Communication, Awareness & Education	School safety clubs, mock drills, and community volunteers.	DDMA, MoCC, Schools, NGOs
	Climate and disaster risk education campaigns	
	Early warning dissemination systems	
Disaster Preparedness & Response	Regularly updated local disaster action plans	DDMA, PMD
	Early warning systems & community communication	
	Provision of shelters and safe evacuation routes	
Urban Planning & Land Development	Zoning of flood-prone and seismic risk areas	P&DD, SIDA, MC
	Relocation of high-risk households	
	Land use policies to protect catchment and easements	
Housing	Flood-proof housing and earthquake-resistant designs	SBCA, BOR
	Climate-resilient construction codes	
	Secure land tenure for relocation housing	

Source: *The Consultant Team*

The successful implementation of this framework hinges on the proactive coordination led by the District Disaster Management Authority (DDMA), which will facilitate regular inter-departmental meetings and monitor progress against the stated timelines and indicators. The Planning & Development Department (P&DD) plays a critical role in ensuring these resilience measures are integrated into the annual development plans and projects for Khairpur District. This sector-based approach ensures that resilience is not an add-on but a fundamental principle of urban and rural development, directly addressing the vulnerabilities identified in the MHVRA, particularly riverine floods, drought, heatwaves, and reflecting lessons from past disaster events in the district.

11.8.2 Early Warning System (EWS)

An effective Early Warning System (EWS) is a critical lifeline for Khairpur District, enabling a transition from disaster response to proactive risk reduction. The system's effectiveness hinges on its ability to generate timely alerts and ensure they reach every at-risk individual, who must understand the message and know how to act. Based on the MHVRA findings and lessons from past flood events (2011, 2012, 2015), Khairpur's EWS will leverage a multi-channel approach to guarantee "last-mile" connectivity, especially for vulnerable and remote communities in 13 flood-prone Union Councils.

The system will be activated based on triggers from the Pakistan Meteorological Department (PMD) and the Sindh Irrigation Department regarding river levels, rainfall forecasts, and heatwave alerts. The dissemination protocol is outlined below, detailing the escalation from alert to immediate action.

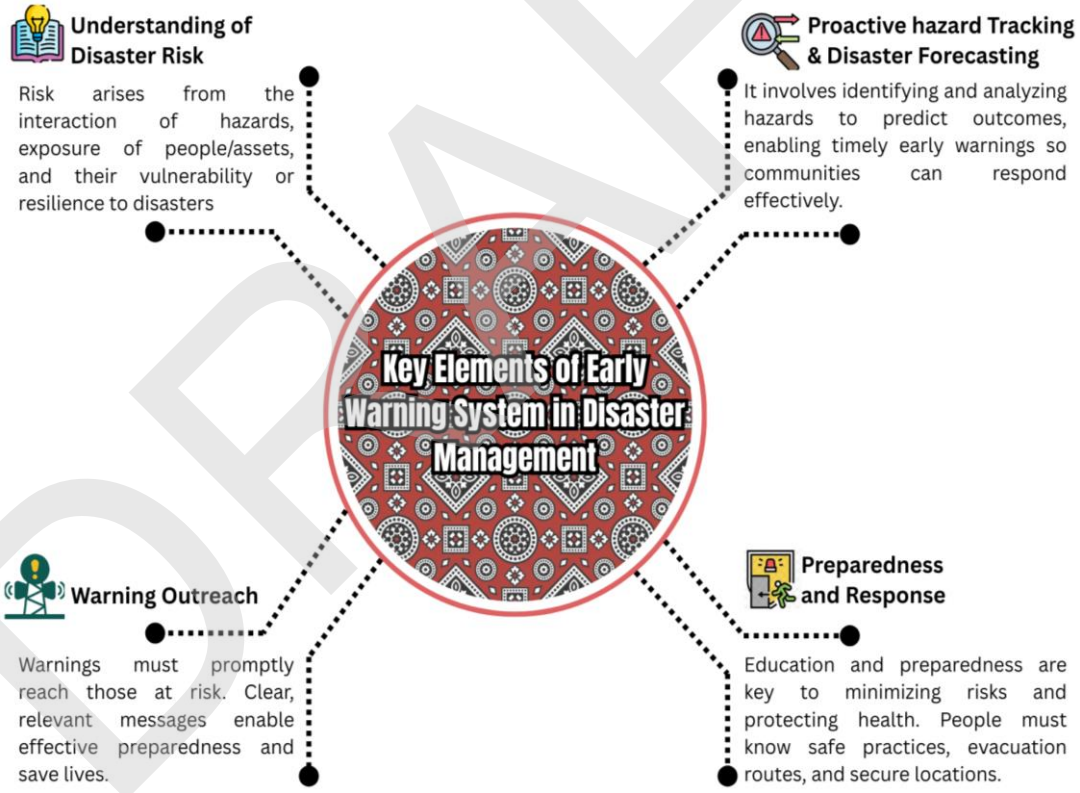


Figure 4-1, Key Elements of Early Warning System in Disaster Management

Source: *The Consultant Team*

Table 11-10, Early Warning Dissemination Protocol for District Khairpur

Warning Level & Trigger	Dissemination Channels	Required Actions by Authorities & Communities
ALERT (72–48 hours before event)	• SMS alerts to registered community contacts.	• DDMA and Irrigation Department intensify monitoring of

Warning Level & Trigger	Dissemination Channels	Required Actions by Authorities & Communities
PMD forecast of heavy rainfall in catchment areas. Rising river levels at Sukkur Barrage. Heatwave alert with temperatures exceeding 45°C.	• Initial broadcasts on local FM Radio. • Issuance of Alert to DDMA and line departments via official communication.	embankments. • Communities and volunteers review evacuation plans and check emergency supplies. • Information Department prepares public awareness messages for media.
WARNING (24 hours before event) Confirmed forecast of severe weather or continued heatwave. River flow reaching predetermined danger levels at upstream barrages.	• Repeated SMS and FM Radio broadcasts with specific details. • Mosque loudspeaker announcements in vulnerable UCs. • Mobile vans with megaphones deployed in high-risk areas. • Activation of UC-level WhatsApp groups by UCDMC.	• DDMA and Police finalize evacuation routes and resource deployment. • Communities secure livestock and prepare to evacuate if required. • Revenue Department pre-activates designated shelters in safe locations.
IMMEDIATE ACTION (Evacuate) Imminent breach warning or rapid rise in water levels. Extreme heatwave posing severe health risks. Direct evacuation order from PDMA/DDMA.	• Continuous sirens (where installed). • Door-to-door alerts by Police and Community Volunteers. • Direct calls to UC Administrators and village leaders.	• DDMA and Transport Department coordinate evacuation vehicles. • Police manage traffic and ensure safe passage. • Communities evacuate immediately to pre-identified shelters.

Source: *The Consultant Team*

11.8.3 Community Based Disaster Risk Management

Community-Based Disaster Risk Management (CBDRM) emphasizes local community participation in disaster preparedness, mitigation, and response. While the government holds the main responsibility for disaster services, community involvement is essential for long-term success. Projects that ignore local needs and culture risk failure, so effective disaster management must be people-centered and built on partnerships with communities.

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CBDRM offers key advantages including reduced vulnerability, strengthened resilience, fostered hope and self-reliance, support for resilient local economies, and allows testing of risk reduction strategies at the community level.

In Khairpur district, where riverine floods, droughts, and heatwaves are frequent hazards, CBDRM is especially critical. By raising awareness, building capacity, valuing indigenous knowledge, and forming local disaster committees, the framework aims to create resilient communities capable of minimizing risks and effectively responding to emergencies.

Core Community Structures: From Planning to Action

To operationalize CBDRM, the following structures will be established in each of the 70 Union Councils, with clear linkages to the District and Taluka disaster management authorities:

- Union Council Disaster Management Committees (UCDMCs) will be the cornerstone of local action, chaired by the UC Administrator and including members from local NGOs, CBOs, mosque leaders, and representatives from vulnerable groups.
- Each UCDMC will facilitate the formation of Community Disaster Volunteer (CDV) Teams comprising 20-30 local volunteers. These teams will be trained in first aid, light search and rescue, and early warning dissemination.
- All secondary schools in the district will establish School Safety Clubs to conduct regular drills and raise awareness among students, who act as powerful messengers within their families.

A. Phased Implementation of Community-Based Disaster Risk Management (CBDRM)

The following framework outlines a practical, phased approach to establishing and sustaining CBDRM in Khairpur District. This process transforms community engagement from a one-time consultation into a continuous cycle of planning, action, and improvement, directly managed by the communities with support from the DDMA and local authorities.

Table 11-11, Phased CBDRM Implementation Framework for Khairpur District

Phase	Key Components	Specific Activities & Outputs
Phase 1: Foundation & Assessment (Months 1-3)	1. Community Mobilization & Mapping 2. Vulnerability & Capacity Assessment (VCA)	• Demarcate the community boundary for the CBDRM unit (village or mohalla). • Map local leaders, schools, businesses, mosques, CBOs, and representatives of women, elderly, and persons with disabilities. • Use community mapping and

Phase	Key Components	Specific Activities & Outputs
		discussions to identify local hazards (floods, heatwaves, drought) and existing resources.
Phase 2: Planning & Institutionalization (Months 4-6)	3. Formulate the UC Disaster Management Plan 4. Establish Governance Structure	• Define clear goals for disaster risk reduction specific to the community. • Create prioritized actions (e.g., clear drainage channels, mark evacuation routes to shelters). • Formally appoint teams for Early Warning, Evacuation, First Aid, and Shelter Management.
Phase 3: Implementation & Capacity Building (Months 7-12)	5. Resource Mobilization & Training 6. Implementation of Actions	• Identify local resources and seek external support from DDMA/NGOs where needed. • Train Community Disaster Volunteers in first aid, light search and rescue, and early warning dissemination. • Begin implementing prioritized actions from the community disaster plan.
Phase 4: Monitoring, Evaluation & Sustainability (Ongoing)	7. Drills & Simulation Exercises 8. Review and Update 9. Coordination with Authorities	• Test the community's plan through simulation exercises for floods and heatwaves. • Revise the community disaster plan based on drill outcomes and new hazards. • UCDMC will regularly report to Taluka and District Disaster Management Authorities (TDMC/DDMA).

Source: The Consultant Team

11.8.4 Evacuation Plan

The evacuation plan for Khairpur District is designed to ensure the safe, orderly, and timely relocation of populations from hazard-prone areas. The plan is activated for two primary scenarios:

- Riverine Floods: Relocating populations from the 214 identified settlements within the riverine flood plain.
- Earthquakes: Relocating populations from areas with vulnerable infrastructure and collapsed buildings.

Evacuation will be to the network of designated shelters identified in the district.

F) Pre-Evacuation Preparedness

- Primary shelter locations, as geo-referenced in the district map, will be clearly mapped and marked with signage. These shelters have differentiated capacities based on the hazard:
  - Flood Scenario: Shelters can accommodate approximately 8,180 tents.
  - Earthquake Scenario: Shelters can accommodate approximately 70,100 tents.

  Their selection is based on proximity to major roads and critical facilities for optimal accessibility.
- Evacuation routes will utilize the National Highway (N-5) network and other major roads. Secondary and link roads will be identified for access to vulnerable neighbourhoods, as illustrated in the district shelter location maps. The proximity of settlements to key infrastructure like 139 mobile towers will be leveraged for communication. Routes will be assessed post-earthquake for usability.
- Regular, hazard-specific awareness campaigns will be conducted in at-risk Union Councils (UCs). Evacuation drills for both flood and earthquake scenarios will be organized in collaboration with Union Council Disaster Management Committees (UCDMCs) to ensure community readiness.
- A pre-planned emergency traffic management protocol will be prepared by relevant departments (e.g., Police, National Highway Authority) to ensure efficient mobility and prevent congestion on evacuation routes.

G) Activation and Execution

- Activation trigger for:
  - Flood: Evacuation orders will be triggered based on early warnings disseminated by the Provincial Disaster Management Authority (PDMA) via the District Emergency Operation Center (DEOC).
  - Earthquake: Evacuation will be immediate and based on rapid damage assessments conducted by the DDMA and frontline responders following the seismic event.
- Upon activation, the District Disaster Management Authority (DDMA) will lead the effort, mobilizing police (from the 16 police stations identified) for security and traffic control. The Taluka Disaster Management Committees (TDMCs) and UCDMCs will act as frontline responders, guiding people from their communities.

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- Specific arrangements, including dedicated transport, will be made for the safe evacuation of vulnerable groups (elderly, persons with disabilities, women, children). Coordination with nearby 79 health facilities will be critical for medical support during transit, especially in an earthquake scenario.

H) Shelter Management

- Designated shelters will be equipped with essential facilities managed by the DDMA in coordination with line departments and NGOs. This includes provisions for water, sanitation, food, and basic healthcare. The larger capacity for earthquakes anticipates a greater need for temporary housing.
- Trained personnel, including volunteers from Social Welfare and community-based groups, will manage shelter registration, crowd control, and the distribution of relief goods.

I) Return and Rehabilitation

- The return of evacuees will be permitted only once the relevant authorities (PDMA/DDMA for floods, building safety inspectors for earthquakes) declare conditions safe.
- Rehabilitation, guided by the "Build Back Better" principle, will be coordinated by the PDMA and DDMA. This includes support for temporary housing, restoration of livelihoods, and healthcare services in collaboration with government departments and partner organizations.

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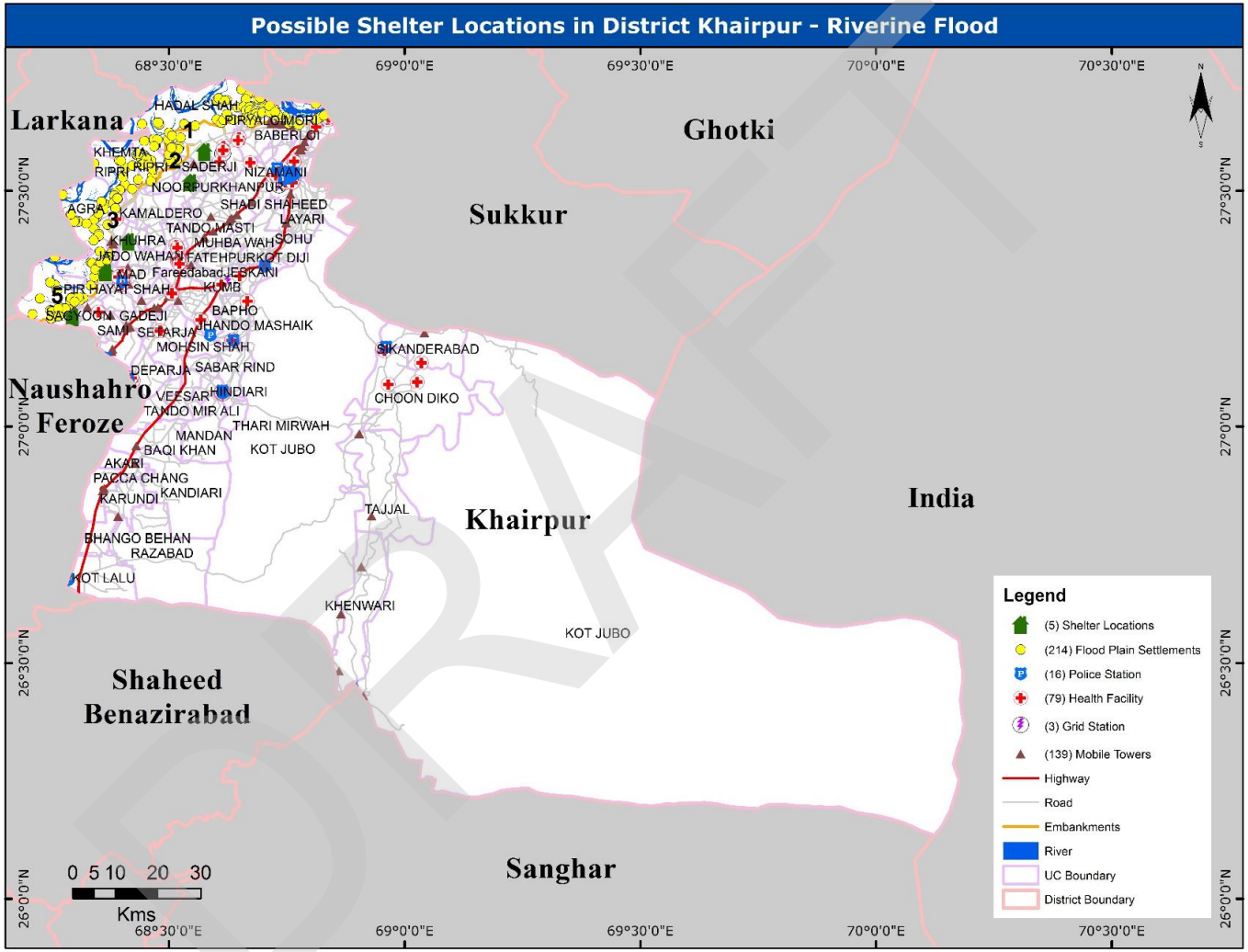


Figure 11-16, Shelter Locations in District Khairpur – Riverine Flood

Source: *MHVRA Khairpur District, 2023-2032*

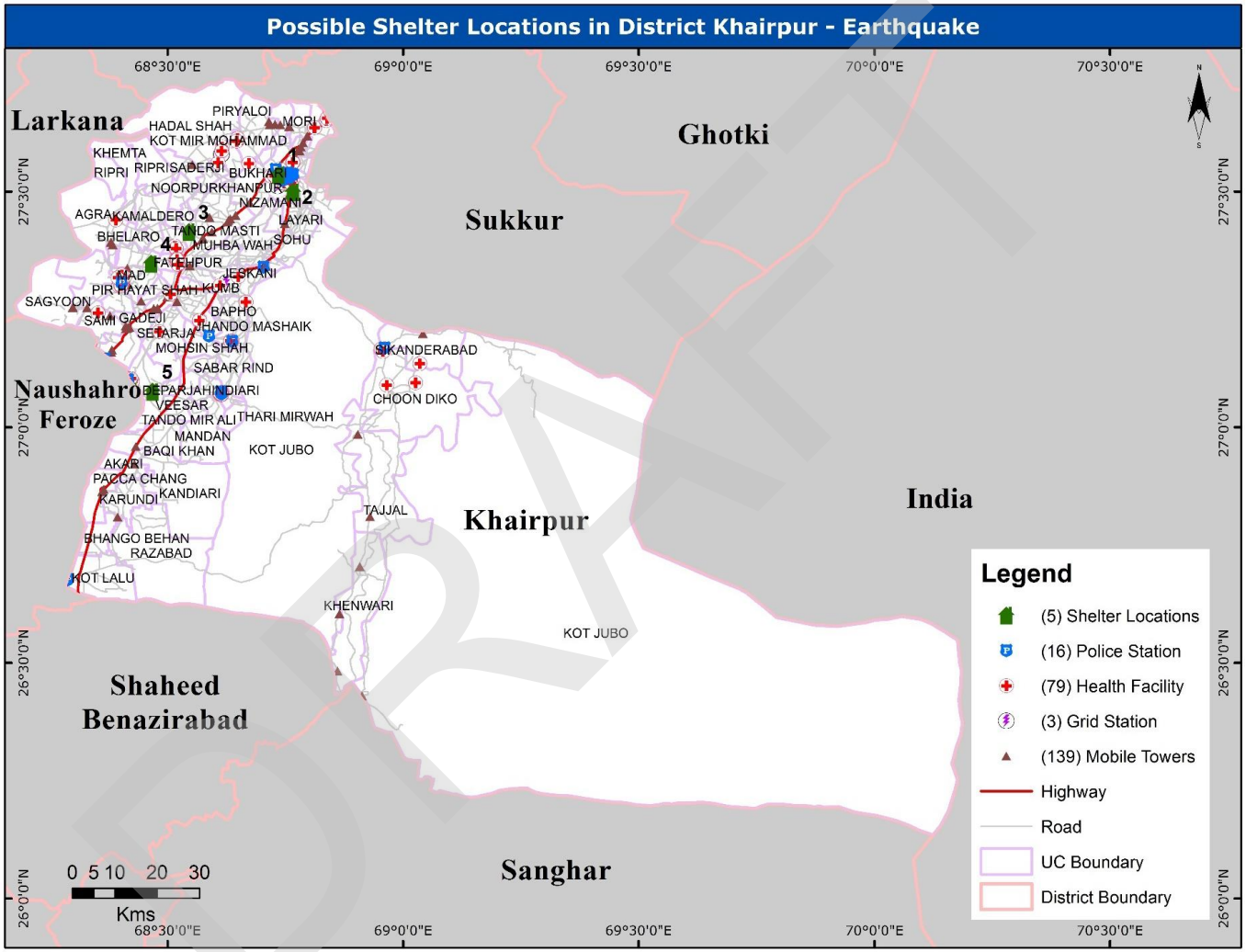


Figure 11-17, Shelter Locations in District Khairpur – Earthquake

Source: *MHVRA Khairpur District, 2023-2032*

11.9 Strategic Framework for Disaster Risk Reduction

11.9.1 Policy Guidelines

A. Integrate Disaster Risk Reduction (DRR) into Urban Planning

- Incorporate hazard and vulnerability assessments into all stages of urban development.
- Ensure infrastructure, housing, and land use decisions are based on risk data.
- Reduce exposure to hazards by avoiding high-risk zones (e.g., floodplains, fault lines).
- Support resilient city growth to minimize future disaster impacts.

B. Regulate Encroachments in Floodplains and Illegal Bunds

- Enforce laws to prevent construction in flood-prone or environmentally sensitive areas.
- Demolish unauthorized bunds and structures that obstruct natural drainage.
- Monitor land use regularly to deter further encroachments.
- Protect water flow and flood mitigation zones to reduce disaster risk.

C. Promote Green Infrastructure and Resilient Agriculture

- Increase urban greenery (e.g., parks, tree belts) to combat heat and absorb rainwater.
- Implement nature-based solutions like rain gardens, green roofs, and permeable pavements.
- Support climate-resilient farming through drought-tolerant crops and improved irrigation.
- Encourage sustainable practices to reduce long-term vulnerability

D. Increase Urban Greenery (e.g., Parks, Tree Belts) To Combat Heat and Absorb Rainwater

- Implement nature-based solutions like rain gardens, green roofs, and permeable pavements.
- Support climate-resilient farming through drought-tolerant crops and improved irrigation.
- Encourage sustainable practices to reduce long-term vulnerability.

E. Strengthen Community-Based Disaster Risk Management (CBDRM) Programs and Local Capacity Building

- Involve communities in identifying local hazards and planning risk-reduction activities.

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- Provide training and resources to improve disaster preparedness at the grassroots level.
- Empower local leaders and volunteers to act as first responders.
- Enhance public awareness campaigns and mock drills through inclusive participation in DRM efforts.

F. Mainstream Fire Safety in Urban Development

To ensure comprehensive disaster resilience, fire safety must be integrated as a key policy priority in Khairpur's urban management framework.

- Ensure full compliance with the Building Code of Pakistan – Fire Safety Provisions 2016 (BCP-FSP 2016) for all building types.
- Enforce routine audits of industrial, commercial, and high-rise buildings, applying penalties for non-compliance.
- Maintain adequate separation between industrial and residential areas and ensure dedicated emergency access routes.
- Include fire safety modules in school and university curricula to build long-term awareness.
- Define evacuation routes, assembly points, and conduct regular fire drills in schools, markets, and neighborhoods.
- Upgrade training facilities and collaborate with the *National Institute of Fire Technology* for advanced courses.
- Create a centralized database to record and analyze fire incidents for proactive planning.

G. Enhance Security and Risk Management for Crowded Places

- Identify, map, and periodically review crowded places such as transport hubs, religious institutions, commercial centers, and public venues to assess security risks.
- Ensure installation of CCTV, controlled access points, and emergency evacuation procedures in high-footfall zones.
- Engage law enforcement agencies (Police, CTD, NACTA), local authorities, and private facility managers to jointly plan and implement protective measures.
- Conduct awareness campaigns and mock drills in markets, schools, and religious areas to enhance public readiness during emergencies.

H. Risk Based Planning Through Vulnerability and Hazard Assessments

- Collect data to identify vulnerable groups (e.g., women, elderly, low-income communities).
- Analyse geographical and systemic risks for targeted planning.
- Prioritize high-risk areas for resource allocation and intervention.
- Design evidence-based, technically sound DRM strategies tailored to specific needs.

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I. Build on Existing Community Structures and Coping Mechanisms

- Utilize established community organizations and local leadership.
- Leverage traditional practices and local knowledge in DRM planning.
- Increase community trust and support by involving familiar structures.
- Ensure long-term sustainability by embedding interventions in local systems.

J. Include Women as Key Stakeholders in DRM

- Recognize women's vital roles in families and communities during disasters.
- Address gender-specific vulnerabilities and inequalities in DRM planning.
- Involve women in decision-making and early warning systems.
- Strengthen resilience by leveraging women's unique skills and perspectives.

K. Define Roles and Responsibilities Across Government Levels

- Clearly allocate DRM roles among local, provincial, and national authorities.
- Avoid duplication and gaps through well-defined responsibilities.
- Ensure smooth communication and coordination during emergencies.
- Enable faster, more efficient response through structured governance.

11.9.2 Strategic Development Plan

The Strategic Development Plan aims to build a resilient Khairpur through integrated disaster risk management, reducing vulnerabilities to natural and man-made hazards, including fire-related emergencies. The plan emphasizes preparedness, institutional coordination, and infrastructure enhancement.

A. Long Term Plan

National risk assessment would identify highly vulnerable districts and be complemented by higher resolution work at local level to diagnose the underlying causes of risk, explore concrete risk reduction options and inform development planning and prioritization exercises and/ or disaster preparedness planning.

- Assessments should be conducted using a uniform methodology and process for multi-hazard vulnerability and risk assessment so they can help to refine the national/ provincial data-bases.

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- DRR needs to address and involve local level actors in high-risk communities to be effective
- and produce sustainable results. Provide disaster relief centres is high risk areas for shelter is higher. Places with medical facilities and food distribution centres.
- There is a need to have clear arrangements that allow the system to switch into emergency mode and mobilize necessary resources in a timely and effective manner.
- Establish multi-hazard disaster relief centers in high-risk zones.
- There is need to clarify mutual roles and responsibilities (horizontal and vertical) and coordination arrangements in an updated, multi-hazard national response plan that is based upon current legislation.
- Integrate fire services infrastructure within urban development plans by:
  - Upgrade existing fire stations as per *NRM* and *BCP-FSP 2016* standards.
  - Allocate a minimum of **2,025 sq. m (~4 kanals)** for each firefighting station with adequate training and storage facilities.
  - Expand hydrant networks and ensure water availability in high-risk areas.
  - Establish a centralized fire incident database and integrate it with the city's emergency response system.
  - Integrate safety measures for soft targets into master plans, including transport terminals, religious centers, and public venues.
  - Strengthen inter-agency coordination for threat assessment and response.
  - Promote continuous risk monitoring and stakeholder engagement.

B. Short Term Plan

- Provision of the right to timely emergency care by providing quality
- emergency service as per international standards.
- Creating an integrated District and provincial level capacity to identify and Monitor vulnerability and hazard trends including potential climate change impact.
- Strengthening an integrated disaster preparedness and response capacity from the local to the national level.

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- Promoting development planning that considers and addresses disaster risks alongside environmental and climate change concerns.
- Strengthening capacity at national and provincial levels to facilitate and
- provide support to the implementation of DRM policies, plans and programs across sectors and in high-risk areas
- Strengthening Local Level Risk Reduction capacity focusing upon communities, and supportive linkages with Union Councils, tehsils and districts.
- Strengthening the structural and non-structural resilience of key infrastructure and lifelines in Pakistan.
- Rapid Response Fire Services: Establish compact fire sub-stations with specialized vehicles for congested neighborhoods.
- Emergency Preparedness: Identify and mark emergency access routes, fire lanes, and safe assembly points.
- Firefighting Capacity Building: Procure firefighting tools (breathing apparatus, foam units, rescue kits) and train staff in coordination with the National Institute of Fire Technology.
- Crowded Places Safety Measures:
  - Develop a GIS-based inventory of crowded places with risk profiling.
  - Install CCTV, communication systems, and controlled entry points at major public areas.
  - Conduct joint training for police, emergency services, and facility managers on crowd management and threat response.
  - Integrate public awareness programs on fire safety, evacuation drills, and emergency behavior.

11.9.3 Priority Projects

- **Establish a Risk Assessment Framework**
  - Develop clear criteria for declaring disaster-affected areas to ensure transparent and timely response.
  - Base disaster risk management (DRM) strategies on comprehensive hazard and vulnerability assessments, combining both quantitative and qualitative analyses of potential losses and geographic exposure.

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- **Develop an Integrated Multi-Hazard Data and Monitoring System**
  - Create a centralized digital database to record, analyze, and monitor all disaster events, including floods, fires, and security-related incidents in public areas.
  - Enable evidence-based planning, informed decision-making, and continuous risk monitoring through GIS integration and real-time reporting mechanisms.
- **Strengthen Flood Risk Mitigation and Response Mechanisms**
  - Implement structural and non-structural measures to reduce flood impacts, such as strengthening embankments, improving drainage systems, and establishing community-based early warning and evacuation plans.
  - Designate and equip safe shelters with essential services to ensure the protection of vulnerable populations during flood emergencies.
- **Enhance Fire Safety and Public Space Security**
  - Upgrade existing fire stations, establish new ones at strategic locations, and deploy additional fire engines, water tankers, and mobile units for rapid response.
  - Implement moderate safety enhancement measures in crowded areas through surveillance systems, controlled access, and coordinated response among law enforcement and local authorities.
  - Promote community-level fire safety education, awareness campaigns, and regular evacuation drills.
- **Build Capacity and Strengthen Emergency Response Preparedness**
  - Establish certified training programs for first responders in partnership with relevant national institutions.
  - Equip response teams with modern tools, communication systems, and medical supplies.
  - Conduct multi-agency simulation exercises involving police, firefighters, and health departments to ensure efficient coordination and operational readiness.

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SECTION - 12: CLIMATE CHANGE, RESILIENCE AND ADAPTABILITY PLAN

12.1 Introduction

District Khairpur, located in the arid zone of Sindh, is increasingly exposed to climate-induced hazards that threaten the region's socio-economic stability, ecological balance, and human well-being. The combined impacts of changing weather patterns, rising temperatures, and erratic precipitation have heightened the district's vulnerability to floods, droughts, and extreme heat events. Understanding these hazards, both in their current form and projected future severity is essential for effective climate adaptation, risk reduction, and sustainable planning. While the hazard mapping and climate projections are available at the district level, the plan will be implemented at the city level as well to build resilience for the future.

12.1.1 Climatology of Pakistan

A. Temperature Trends

Pakistan has experienced an increase in average temperatures over the past century, with a rise of approximately 0.57°C. The warming has been more pronounced in southern areas, including Sindh, where winter temperatures have increased by 0.91°C to 1.12°C. This warming trend accelerates during winter and post-monsoon months. The highest temperatures are recorded in June, while the lowest occur in January, reflecting distinct seasonal temperature variations across the country.

B. Precipitation Patterns

Historically, rainfall in Pakistan has been inconsistent. While the northern regions see higher rainfall, the southern plains, including Sindh, have seen a decrease in rainfall. The country is also experiencing increased heavy rainfall events, contributing to both floods and droughts. The monsoon season, which peaks in July and August, accounts for most of Pakistan's annual precipitation. The trends indicate a shift in rainfall distribution, with more frequent intense rainfalls and extended dry periods.

12.1.2 Overview of Climate Change in Pakistan & Sindh

A. National Vulnerability

Pakistan is ranked among the top 10 countries most vulnerable to climate change impacts, despite its low contribution to global greenhouse gas emissions. Climate change in Pakistan has led to extreme weather events like floods, droughts, heatwaves, and unpredictable rainfall. This is exacerbated by Pakistan's dependency on agriculture, which is highly sensitive to climate fluctuations. Additionally, population growth, poverty, and limited resources make the country even more susceptible to climate impacts.

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B. Climate Change Impact in Sindh

Sindh is one of the most climate-vulnerable provinces in Pakistan. It faces multiple climate hazards:

- Flooding: Sindh, particularly districts along the Indus River, faces significant flood risks due to glacial melt in the upper catchment and increasing rainfall in the lower catchment areas. The province has witnessed severe floods in 2010 and 2013, displacing thousands and causing extensive damage to infrastructure, agriculture, and livelihoods. In 2022, floods covered nearly one-third of Sindh, with the northern districts being the most affected.
- Heatwaves: Heatwaves in Sindh are becoming more frequent and intense. From 1961 to 2011, the frequency of heatwaves, particularly those above 45°C, has significantly increased. In June 2015, over 1,200 deaths were attributed to a heatwave in Sindh. With global warming, heatwaves are expected to become more severe, with rising health risks, particularly to vulnerable populations.
- Coastal Zone Vulnerability: The Sindh coastline is particularly susceptible to sea-level rise. Areas like the Indus Delta are already seeing the effects of saline intrusion, causing land degradation and impacting agriculture and local communities. The coast is also vulnerable to erosion, with some areas experiencing erosion rates of up to 176 meters per year.
- Water Scarcity: Sindh's water resources are under severe stress. The province depends on the Indus River for irrigation, but irregular river flows, combined with reduced rainfall and increased evaporation, are exacerbating water scarcity. Groundwater levels are rising due to extensive irrigation, contributing to salinity and waterlogging, which further reduce agricultural productivity.

12.1.3 National and Provincial Climate Change Governance Framework

A. National Policies

At the national level, Pakistan has established climate policies, including the National Climate Change Policy (NCCP) of 2012, which provides the framework for addressing climate impacts. The Nationally Determined Contributions (NDCs) under the Paris Agreement commit Pakistan to reducing greenhouse gas emissions by 50% by 2030, with a 35% reduction conditional on international support.

B. Sindh's Climate Change Policy

In response to the growing climate challenges, the Sindh Climate Change Policy was formulated in 2022. This policy is designed to complement national efforts while addressing Sindh's specific climate vulnerabilities. It emphasizes a localized approach to climate change mitigation and adaptation, integrating resilience-building measures tailored to the province's unique environmental, social, and economic conditions.

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C. Governance Mechanisms

The provincial climate governance is led by the Environment Climate Change and Coastal Development Department (ECC&CDD), which oversees the implementation of climate change actions. Key bodies such as the Sindh Environmental Protection Agency (SEPA), the Sindh Coastal Development Authority (SCDA), and the Sindh Irrigation Development Authority (SIDA) play critical roles in implementing climate policies, focusing on environmental protection, coastal resilience, water management, and sustainable agriculture.

12.2 Existing Hazards

District Khairpur has been increasingly affected by various indicators of climate change over the past five decades. Key observed trends include:

12.2.1 Rising Temperatures

Long-term data (1974 – 2024) highlights a gradual increase in average temperatures, with 2004 marking the warmest year at 28.1° C. This warming trend, particularly in summer months, has intensified heat stress in both urban and agricultural areas.

12.2.2 Variability in Precipitation Patterns

Rainfall has become increasingly erratic, with periods of drought interspersed with intense rain events. Although Khairpur was less affected by the 2022 Sindh floods, the region experienced its highest annual rainfall of 553 mm that same year. These changing patterns are impacting water availability and groundwater recharge.

12.2.3 Intensification of Heatwaves

Increased average and extreme temperatures have led to more frequent and severe heatwaves, exacerbating public health risks, water shortages, and agricultural stress, particularly before the monsoon and during peak summer.

12.2.4 Increased Flood Risk

Flood events have become more pronounced, with significant expansion in floodwater coverage between 2010 and 2022. In 2022, approximately 20% of the Municipal Committee (MC) Khairpur area was submerged, compared to no inundation in 2010.

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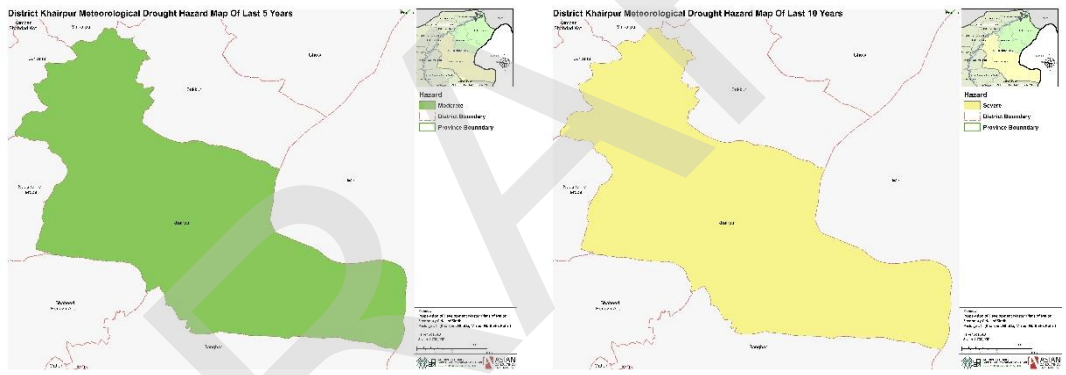
12.3 Potential Future Hazards

12.3.1 Flood

Although flood damage was observed in northern areas near the Indus River during the 2022 event, the overall flood hazard in District Khairpur is currently classified as none too low for 5- and 10-year projections, particularly in the central and southern regions due to higher elevation. However, future flood risks may rise due to climate change impacts such as erratic rainfall and rising river levels.

12.3.2 Meteorological Drought

Persistent dry conditions from below-average rainfall have placed District Khairpur under increasing meteorological drought stress. Hazard maps **(a)** and **(b)** in **Figure 1-1** indicate a "Moderate" risk over 5 years, escalating to "Severe" over 10 years, signalling prolonged dryness. This trend threatens agriculture, water security, and regional stability.



(a) Hazard Map of 05 Years **(b) Hazard Map of 10 Years**

Figure 12-1, Meteorological Drought Hazard Maps of District Khairpur

Source: *The Consultant Team*

12.3.3 Agricultural Drought

With declining soil moisture and unreliable rainfall, agricultural drought is becoming a serious concern. The 10-year hazard map reveals widespread drought severity across Khairpur, putting food security and farmer livelihoods at heightened risk.

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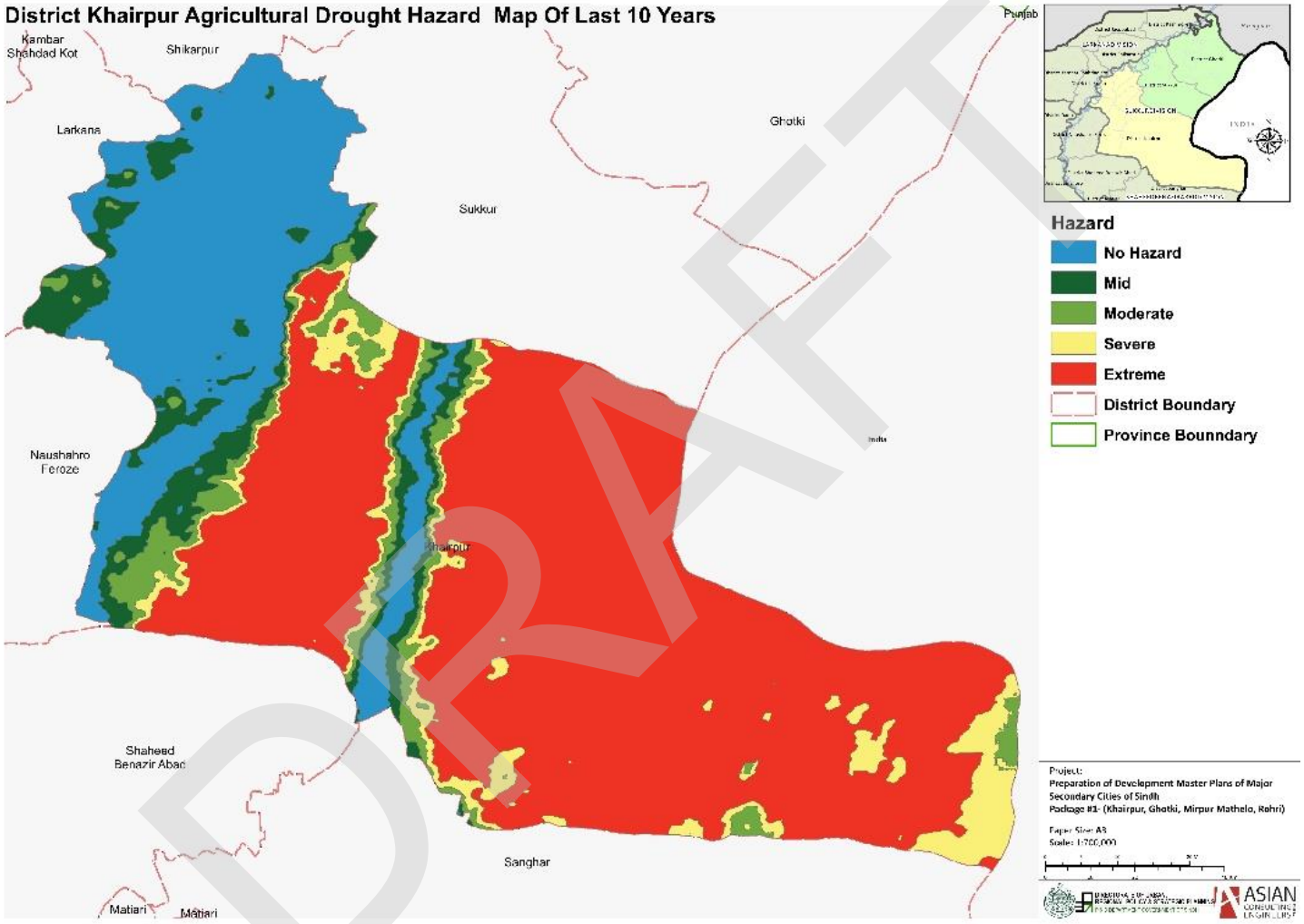
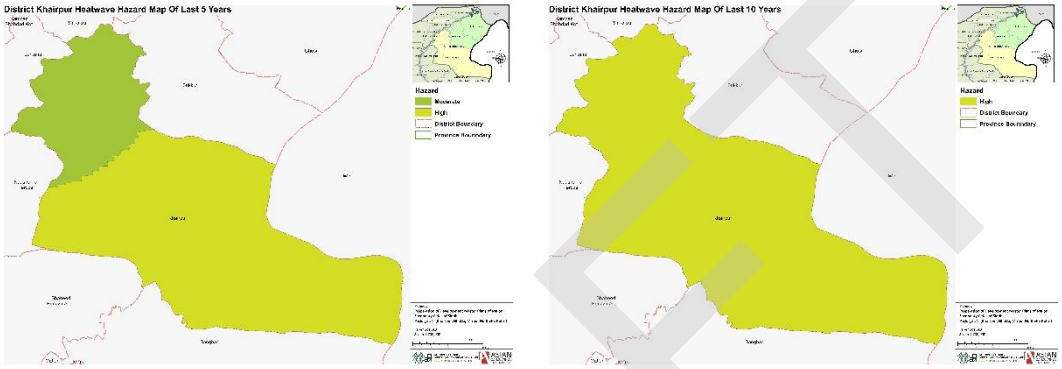


Figure 12-2, Agricultural Drought Hazard Map of District Khairpur

Source: *The Consultant Team*

12.3.4 Heatwave

The frequency and intensity of heatwaves have grown, impacting health, agriculture, and infrastructure. The 5-year hazard map in **Figure 1-3 (a)** shows high-risk zones in central and southern areas, while **Figure 1-3 (b**), the 10-year projection identifies most of the district at high risk, attributed to arid conditions, sparse vegetation, and urban heat island effects. Greener peripheral areas experience relatively moderate risk.



(a) Hazard Map of 05 Years **(b) Hazard Map of 10 Years**

Figure 12-3, Heatwaves Hazard Maps of District Khairpur

Source: *The Consultant Team*

12.4 Climate Resilience and Emergency Contingency Plan

District Khairpur, located in northern Sindh, is highly vulnerable to climate-induced hazards, including riverine and flash floods, agricultural and meteorological droughts, extreme heatwaves, and public health-related emergencies. This Climate Resilience and Emergency Contingency Plan forms a core component of Khairpur's CCRAP, aiming to minimize the loss of lives, protect livelihoods, and ensure effective recovery through a structured and locally adapted disaster response framework. The plan integrates early warning, institutional preparedness, community engagement, and multi-sectoral coordination to ensure climate resilience at the district level. This district-level plan will also be implemented in Khairpur city to enhance local preparedness and adaptive capacity.

12.4.1 Climate-Responsive Disaster Management Strategy

A. Early Warning System and Forecasting

- Pakistan Meteorological Department (PMD) will provide timely weather forecasts, heavy rainfall alerts, and heatwave notifications.
- Flood Forecasting Division (FFD) will issue river flow and flood risk bulletins.

- SUPARCO will support impact forecasting through satellite imaging for high-risk areas.
- District Disaster Management Authority (DDMA) will ensure localized early warnings reach vulnerable communities through radio, loudspeakers, SMS, and CBO networks.

B. Risk-Based Evacuation Planning

- High-risk zones near canals and floodplains to be pre-identified and marked for early evacuation.
- Evacuation routes and safe shelters mapped and disseminated to communities.
- Persons with disabilities, elderly, women, and children to be prioritized during relocation.

C. Emergency Response Coordination

- DDMA Khairpur will operate the District Emergency Operations Centre (DEOC) and serve as the central hub for real-time information and deployment.
- Rescue, medical, food, and shelter units will be coordinated with Health Department, Municipal Committee, Civil Defense, and Police.
- Emergency stockpiles (food, water, tents, medicines) to be pre-positioned by PDMA/NDMA.

12.4.2 Sectoral Preparedness and Response

A. Health Sector

- Pre-deployment of mobile health units and emergency stockpiles.
- Establishment of medical camps in relief sites.
- Disease surveillance and post-disaster vaccination drives.

B. Water, Sanitation & Waste

- Provision of safe drinking water via filtration units.
- Sanitation and hygiene kits for flood-affected households.
- Mobile waste collection in relief areas.

C. Education Sector

- Disaster education in school curricula.
- Schools as temporary shelters.
- Provision of learning materials and psychosocial support post-disaster.

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D. Agriculture & Livestock

- Pre-disaster community seed banks and fodder storage.
- Monitoring of water availability and early disease warning for crops/livestock.
- Post-flood crop loss assessments and farmer compensation schemes.

E. Police and Civil Defense

- Law and order in camps and affected areas.
- Coordination for emergency traffic control and relief security.
- Volunteer mobilization and rescue training.

12.4.3 Community Engagement & Awareness

- Active community engagement is a cornerstone of effective disaster resilience and emergency response in District Khairpur. Ensuring that local populations are informed, prepared, and empowered enhances the overall success of climate adaptation measures.
- Formation of City level disaster risk committees to coordinate local preparedness and response actions.
- Implementation of regular community-based drills and simulation exercises to build preparedness capacity.
- Development and dissemination of user-friendly early warning materials in local languages using visual tools, posters, and audio broadcasts.
- Inclusion of women, youth, persons with disabilities, and minority groups in planning and decision-making processes to ensure equity and representation.
- Engagement of faith-based organizations, schools, and community-based organizations (CBOs) to act as knowledge multipliers.
- Support for local volunteer groups through training in first aid, evacuation procedures, and camp management.
- Integration of climate literacy and disaster risk awareness into school and adult education programs to build long-term community resilience.

12.4.4 Institutional Roles and Standard Operating Procedures (SOPs)

This section outlines clear responsibilities and standard operating procedures (SOPs) for key institutions involved in disaster preparedness, response, and recovery in District Khairpur.

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A. Departmental Roles Overview

Figure 12-4, Departmental Roles Overview

Department	Pre-Disaster	During Disaster	Post-Disaster
District Disaster Management Authority	Risk mapping, early warning prep	DEOC operation, relief coordination	Damage assessment, rehab planning
Health	Stockpiling meds, mobile teams	Treatment, disease control	Camps, vaccinations
Agriculture	Seed/fodder banks, alerts	Crop surveillance	Recovery, compensation
Police	Security planning	Evacuation support	Security for NGOs, camps
Civil Defense	Volunteer training	Rescue & firefighting	Rehab support
Education	Climate change education	Shelter space	Educational continuity
Livestock	Livestock vaccination	Transport & feeding	Loss compensation

B. Key SOPs Across Departments

- **Early Warning Activation:** PMD and FFD to issue timely alerts; DDMA to localize and disseminate warnings to community members.
- **Evacuation and Shelter:** DDMA to identify and manage evacuation routes and temporary shelters; Education Department to allocate schools as shelters.
- **Search and Rescue:** Civil Defense and Police to coordinate rescue missions and ensure safety at relief sites.
- **Medical Services:** Health Department to provide emergency treatment, water testing kits, and disease prevention measures.
- **Livestock & Agriculture:** Livestock and Agriculture Departments to ensure protection of animals and standing crops, including food stock and vaccination.
- **Camp Management:** DDMA and Social Welfare agencies to maintain order, ensure equitable distribution of aid, and oversee basic needs.
- **Information Flow:** All departments to share real-time updates with DDMA for coordinated reporting to PDMA and NDMA.
- **Post-Disaster Rehabilitation:** Departments to assess damage, plan rehabilitation activities, and restore services based on sectoral mandate.

C. Recovery, Rehabilitation, and Climate Resilience Building

The recovery and rehabilitation phase are critical for building long-term climate resilience and ensuring that affected communities can resume normal life safely and sustainably. The following strategies will guide post-disaster recovery efforts:

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- **Restoration of Basic Services:** Immediate reactivation of healthcare facilities, schools, transport systems, and essential utilities.
- **Financial and Livelihood Support:** Compensation for affected households, restoration of agricultural productivity, and employment programs.
- **Climate-Resilient Reconstruction:** Implementation of building codes, construction of flood-resistant infrastructure, and greening of urban and rural spaces.
- **Capacity Building and Institutional Strengthening:** Training for government officials, local councils, and frontline workers to integrate risk-informed planning.
- **Integration into Development Planning:** Align disaster recovery efforts with climate adaptation goals to ensure sustainability and reduce future vulnerabilities.

12.5 Monitoring and Evaluation

To ensure the effectiveness and sustainability of the Climate Change Resilience and Adaptability Plan (CCRAP) for District Khairpur, a robust and inclusive Implementation and Monitoring Framework is essential. This framework is designed to facilitate clear roles and responsibilities, timely execution, multi-sectoral integration, and real-time evaluation of adaptation actions. It aligns with national and provincial resilience goals and emphasizes local ownership and participatory governance. The monitoring framework uses a combination of quantitative, qualitative, process, and impact indicators to assess the success of adaptation interventions.

A. Quantitative Indicators

These are numeric indicators that measure resilience outcomes such as:

- Number of flood-resilient houses built.
- Percentage coverage of drinking water access.
- Number of early warning systems installed.

B. Qualitative Indicators

These involve perceptual or descriptive feedback, often using scoring methods (1-5 scale or positive/neutral/negative), to assess:

- Stakeholder satisfaction with resilience programs.
- Community awareness of disaster risks.
- Inclusivity in planning processes.

C. Process Indicators

Track the execution of adaptation processes:

- Number of stakeholder consultations held
- Integration of resilience in land use and development plans
- Completion of risk assessments or vulnerability studies

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D. Impact Indicators

Assess the long-term outcomes:

- Reduction in climate-related disease incidence
- Reduction in economic losses post-disaster
- Improved food and energy security metrics

12.5.2 Institutional Roles and Responsibilities

A. CCRAP Coordination Committee

Chaired by the Chief Secretary of Sindh, the provincial-level CCRA Coordination Committee will provide overall policy guidance and review district-level progress. It will ensure inter-departmental coordination.

B. District Implementation Team

Led by the Deputy Commissioner of Khairpur, this team will operationalize the CCRAP through nominated focal persons from each sector department.

Table 12-1, Implementation Team and Responsibilities

Department	Focal Agency/Official	Key Responsibility
Local Government	District Commissioner	Oversight and enforcement of district-wide CCRAP activities
Municipal Committee	Chief Officer / ADCs	Execute actions within urban boundaries
Irrigation	District Irrigation Officer	Implement flood management and water resilience actions
Agriculture	District Agriculture Officer	Promote climate-resilient crops and technologies
Health	District Health Officer	Ensure climate-sensitive healthcare facilities and awareness
PHED	Executive Engineer	Improve sanitation and drinking water services
Education	District Education Officer	Integrate climate literacy in schools
Social Welfare	District Social Welfare Officer	Engage vulnerable groups and improve social safety nets
Livestock and Fisheries	District Officer	Protect animal health and promote climate-smart farming
Disaster Management	DDMA District Officer	Early warning systems and disaster preparedness

12.5.3 Monitoring and Evaluation Mechanism

A. District Monitoring Unit (DMU)

Established under the Secretary, Environment and Climate Change Department, and operationalized by SEPA.

Table 12-2, Roles of District Level Implementation Team

Role	Person Responsible	Responsibility
Monitoring Lead	Director SEPA	Lead monitoring strategy and review implementation progress
Engineers	CCRA Engineers	Guide CCRA monitors, prepare technical monitoring reports
Monitors	CCRA Monitors	Field data collection, site validation, community coordination

12.5.4 Monitoring Methods

- **Mixed Methods:** Combining surveys, interviews, focus groups, GIS tools, and administrative data.
- **Local Ownership:** District focal persons are responsible for aggregating reports and data from their sectors.
- **Stakeholder Participation:** Involve CBOs, NGOs, academia, and the private sector for inclusive reporting and learning.
- **Adaptive Learning:** The monitoring system is iterative. Lessons learned will guide future adaptation decisions and plan updates.

12.5.5 Sample Monitoring Indicators for District Khairpur CCRAP

Table 12-3, Sample parameters and Indicators to track performance

Sr. No.	Monitoring Parameter	Monitoring Indicators
1.	Exposure and Risk Assessment	• Number of flood-affected UC-level datasets collected. • % of hazard mapping completed in flood-prone areas.
2.	Resilience Capacity Building	• Number of district staff trained in resilience and adaptation. • % of community-based organizations engaged in climate awareness.
3.	Infrastructure and Services	• % coverage of green spaces and shaded walkways • % of rural and urban population with access to clean water and sanitation.
4.	Livelihoods and Food Security	• % increase in use of climate-resilient seeds. • % decrease in food insecurity levels in drought-affected areas.

UC: Union Council

12.5.6 Reporting and Feedback System

Annual progress reports will be compiled by the District Monitoring Unit and submitted to:

- CCRAP Coordination Committee
- Planning and Development Department
- Public dissemination through district dashboards and public hearing session.

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SECTION - 13: URBAN LAND MANAGEMENT

13.1 Introduction

Land management refers to the strategic use and administration of land resources through appropriate technologies within different land use systems. While the concept is known by various names worldwide, all variations serve as tools for managing land effectively. In Pakistan, however, land management remains largely unpractised due to the absence of comprehensive policies and frameworks. The strong opposition of landowners to forced land acquisition, coupled with the extremely limited fiscal capacity of Local Government has left cities struggling to develop well-planned and serviced urban land. One promising solution to this challenge is Land Pooling and Reconstitution (LPR), a mechanism that enables landowners to collectively share the benefits of increased land value after infrastructure and services are provided. In return, landowners contribute a portion of their land and pay betterment charges to help finance the necessary infrastructure.

13.2 Goals

To establish an effective and sustainable land management framework in Khairpur, by implementing Land Pooling and Reconstitution (LPR) as a tool to optimize land use, address urban development challenges, and promote equitable growth.

13.3 Objectives

- Establish policies and regulations to implement Land Pooling and Reconstitution (LPR) for planned urban growth.
- Identify and utilize underdeveloped land to support sustainable urban expansion.
- Enhance the capabilities of local government bodies for effective land governance and implementation.
- Facilitate the provision of essential urban infrastructure and services through landowner contributions.
- Engage landowners, policymakers, and local communities in decision-making to ensure inclusive development.
- Integrate modern planning techniques to maximize land utilization while ensuring environmental sustainability.

13.4 Need Assessment

In Sindh, the shortage of developable land is not due to a lack of available land but rather stems from inadequate financial resources, limited institutional capacity to service land, and complex land ownership structures dominated by landlords. Additionally, outdated and ineffective land use policies further

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hinder urban expansion and sustainable development. Addressing these challenges requires a shift towards modern, inclusive land management practices that balance landowners' interests with urban development needs.

13.5 Urban Land Management Techniques

Urban land management techniques refer to strategies and tools used to regulate, allocate, and develop land in a way that promotes sustainable urban growth. These techniques ensure efficient land use, prevent urban sprawl, and facilitate infrastructure development. Common urban land management approaches include:

- zoning regulations,
- land readjustment,
- land pooling and reconstitution,
- public-private partnerships, and
- guided land development

Implementing these techniques helps cities optimize land resources, improve liveability, and accommodate future population growth effectively.

13.5.1 Urban Land Management in Khairpur

Khairpur, a historic city with significant economic and strategic importance, faces urban development challenges such as unplanned settlements, inefficient land use, and inadequate infrastructure. The lack of a structured land management framework has resulted in fragmented land parcels and difficulty in servicing new urban areas. To address these issues, a comprehensive urban land management approach is needed, incorporating policies that encourage organized land development, infrastructure provision, and stakeholder participation. Some key approaches include:

- Defining land use categories (residential, commercial, industrial, etc.) to ensure orderly growth.
- A participatory method for assembling land and providing infrastructure.
- Engaging private developers to invest in infrastructure and planned urban development.
- A strategic approach where urban growth is directed towards specific corridors or nodes to prevent haphazard expansion.

13.5.2 Land Pooling and Reconstitution

Land Pooling and Reconstitution (LPR) is a widely used land management tool that facilitates planned urban expansion by consolidating fragmented land parcels and providing essential infrastructure and services. Unlike

traditional land acquisition, which often leads to resistance from landowners, LPR is a participatory and inclusive approach that allows landowners to collectively contribute land for development while sharing the benefits of increased land value.

- Landowners voluntarily contribute a portion of their land to a common pool.
- The pooled land is restructured with proper roads, utilities, and public facilities.
- The remaining land (with better accessibility and services) is redistributed among the original landowners, with a portion allocated for public use.
- The developed land's value increases, and betterment charges are applied to fund infrastructure.

A. Benefits of LPR in Khairpur

LPR offers three key monetary benefits. First, the public agency does not incur the land acquisition cost. Second, the public agency is able to finance urban development through betterment charges and the sale of land. Third, the landowners gain from the appreciation in the land value due to the provision of infrastructure. In addition to monetary benefits, LPR provides several strategic advantages:

- Ensures fair allocation of land while compensating landowners through enhanced land value.
- Facilitates the creation of essential services such as roads, drainage, water supply, and public spaces.
- Encourages voluntary participation, thereby minimizing legal disputes and resistance.
- Creates opportunities for investment in real estate and infrastructure by attracting private developers.

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SECTION - 14: IMPLEMENTATION STRATEGY

14.1 Introduction

This section outlines the implementation framework for the Strategic Development Master Plan of Khairpur City, which aims to guide sustainable urban growth and development up to 2043. The plan provides a structured approach to prioritize, phase, and coordinate development initiatives under the governance framework of the Government of Sindh. It emphasizes stakeholder engagement, transparency, and equitable resource allocation to ensure inclusive and resilient urban development.

Key objectives include:

- Establishing a clear governance and institutional structure for plan execution.
- Defining roles and responsibilities of local governments and agencies.
- Aligning projects with legal and regulatory frameworks.
- Ensuring efficient delivery of physical and social infrastructure.
- Implementing a phased schedule for short-term (1-5 years) and long-term (5-20 years) projects.

14.2 Process of Implementation

The successful execution of Khairpur Strategic Development Plan requires a coordinated, multi-phase approach involving all tiers of government and key stakeholders. This structured implementation process ensures systematic delivery of housing, urban development, and social infrastructure projects while adhering to Sindh's legal framework and addressing local needs.

In accordance with Rule 7-B of the Sindh Building Control Ordinance, 1979 (amended in 2014), the Strategic Development Plan shall be submitted to the Government for consideration and will take effect upon its approval. The implementation process will be carried out through the following measures:

Planning and Prioritization Phase

- Conducted comprehensive needs assessments across for all land uses (residential, commercial, industrial, etc.)
- Prioritized based on urgency (short-term vs. long-term) and impact (environmental, economic growth, sustainability)
- Community consultations, workshops, and feedback loops integrated into final planning

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Regulatory Approvals Phase

- Obtain clearances from SKAA for existing informal settlements
- Secure approvals from Sindh Building Control Authority (SBCA) and Local Government and Planning Departments for new developments
- Obtain necessary building permits and environmental approvals
- Finalize inter-departmental agreements and partnerships

Resource Mobilization Phase

- Allocate government development funds
- Secure financing from local and international development partners
- Identify and prepare project sites

Execution and Construction Phase

- Implement slum upgrading programs through SKAA
- Deliver urban infrastructure projects via Municipal Committee
- Construct social infrastructure facilities

Monitoring and Quality Assurance Phase

- Track progress through digital dashboards
- Conduct regular field inspections
- Implement third-party quality audits

Handover and Sustainability Phase

- Transfer completed projects to local management
- Train local staff and community representatives
- Establish maintenance systems

14.3 Governance System

Local government is the only means of managing development in the Sindh province. It exercises jurisdiction over its local area, excluding any "Notified Areas" where relevant departments operate. The overall administrative control over local governments is with the Sindh Local Government Department. There are a large number of local governments and other agencies across the Sukkur division with land use planning responsibilities or responsibilities for delivering the required supporting physical and social infrastructure to support population growth.

14.3.1 Sindh Local Government Department

1. Roles and Responsibilities

Under the Sindh Local Government Act 2013 (2021 Amendment), the roles and responsibilities (as per Sections 10 – 16) of different local government tiers in Sukkur Division. The Act establishes a hierarchical system of local governments.

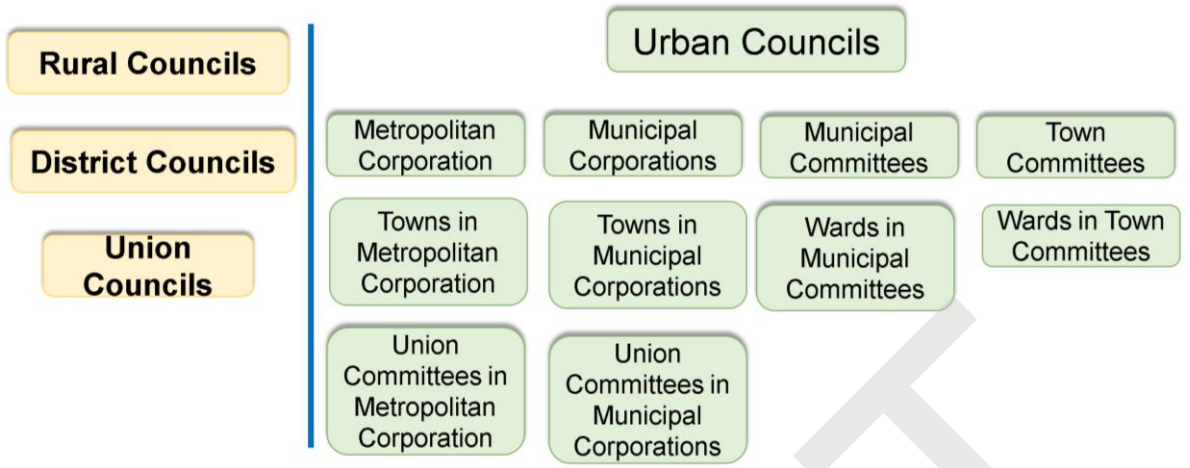


Figure 14-1, Local Councils

Source: *Local Government Department, Government of Sindh*

- The Minister for Local Government & Housing Town Planning (HTP) provides political leadership for all planning and development processes in the local government system and gives final approval for major development and master plans.
- The Secretary Local Government & HTP acts as the chief administrative head, overseeing planning proposals, ensuring compliance with policies, and coordinating between various departments and local councils.
- The Special Secretaries (Local Government, Housing, Town Planning, Technical Services) conduct technical evaluations of development and master plans to ensure legal, zoning, environmental, and infrastructure standards are met.
- The Directors and Deputy Secretaries are responsible for the administrative processing of development proposals, vetting documents for accuracy, and ensuring timely submission for decision-making.
- The Section Officers and Research Officers carry out detailed scrutiny of development files, including legal checks, financial analysis, technical drawings, and environmental compliance before sending proposals to higher authorities.
- The Regional Directors Local Government (LG) serve as the link between the provincial department and local councils, providing technical guidance, overseeing project implementation, and ensuring compliance with approved master plans.
- The Sindh Local Government Board (SLGB) manages human resources, staffing, training, promotions, and disciplinary matters for local government employees to ensure councils have qualified personnel for project implementation.

- The Municipal Committees (MCs), District Councils, Town Committees, and Union Councils are the key on-ground bodies that Prepare development and master plans, execute infrastructure and community development projects, manage municipal services like roads, sanitation, water, waste, and public spaces, ensure public engagement, compliance, and financial management.
- The Municipal Officers, Engineers, Planners, and Technical Staff working under local councils handle the physical implementation of projects, supervise works on-site, and report project progress to higher authorities.
- The Provincial Government retains the right to inspect, supervise, and intervene if any council fails to perform, misuses funds, or violates planning laws.

Approval Process of Master Plan

- Preparation of Master Plan is initiated under the Sindh Local Government Act, 2013, Sections 17, 18, 20 which empower local councils and planning agencies to prepare development plans.
- Sindh Government or relevant Development Authority (e.g., KDA, LDA, MDA, SDA, HDA) hires a registered Town Planner or consultancy firm (registered with PCATP) to prepare the plan.
- Internal Review of Draft Plan (20-45 days) by the Technical Review Committee (TRC) formed by the Development Authority or Planning Department.
- Public Hearing and Consultation sessions conducted as per Environmental Protection Act, 2014, and Planning Procedure Guidelines to ensure stakeholder participation.
- After incorporating feedback, the Revised Draft Master Plan is submitted to the District Planning & Design Committee (DPDC) under the Sindh Local Government Department.
- Once approved at the district level, the plan is forwarded to the Sindh Local Government Department (LGD) or Physical Planning & Housing Department for Provincial Review.
- The final plan is submitted to the Sindh Chief Minister or Sindh Cabinet for Administrative Approval.
- Upon CM/Cabinet approval, the Master Plan is notified in the Official Gazette, making it a legal planning document.
- The notified plan is sent to all implementing agencies: development authorities, municipal corporations, and planning departments for enforcement.
- Plan is monitored and updated periodically (every 10–20 years) as per planning practice and government directives.

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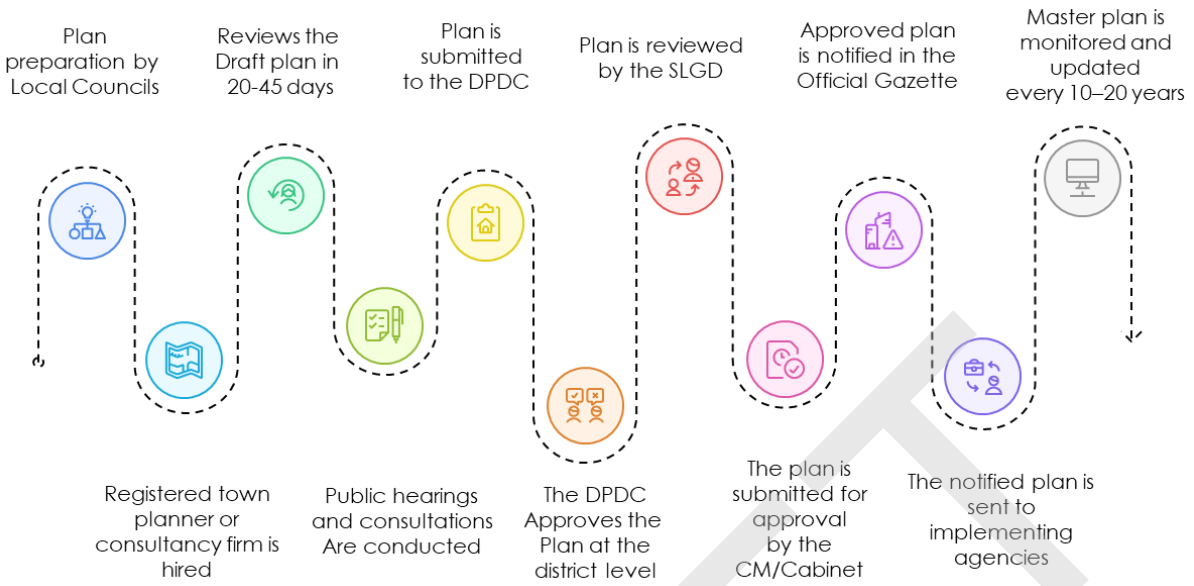


Figure 14-2, Approval Process of Master Plan

Source: *Local Government Department, Government of Sindh*

2. Union Councils (UCs)

Union Councils (UCs) form the foundational tier of local governance, primarily focusing on grassroots administration. While they lack land use planning authority, UCs are responsible for vital functions such as maintaining socio-economic data, registering births and deaths, and providing basic services including public drinking water sources and local waste management. Their role in community dispute resolution through Musalihat Anjuman (conciliation committees) further strengthens local governance.

3. Town Committees (TCs)

Town Committees govern smaller urban areas with populations between 15,000 and 24,999, such as Ubauro, Therhi, Babarloi and Adilpur. Their responsibilities include approving intra-town development schemes and managing municipal infrastructure (Section 14(1)(d)) like street lighting, roads, parks, graveyards, and community centres. These committees serve as intermediaries between rural and urban governance structures.

4. Municipal Committees (MCs)

For larger urban centres with populations ranging from 25,000 to 499,999, Municipal Committees (MCs) in cities like Khairpur, Ghotki, Rohri, Mirpur Mathelo, assume broader authority. They possess land use planning powers, enabling them to prepare and enforce zoning regulations and master plans (Section 12(2)(a)). MCs also regulate private housing schemes, exercise building control, and oversee commercial licensing while performing all functions of Town Committees.

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5. Municipal Corporations (MCs)

Major cities like Sukkur, with populations exceeding 500,000, are governed by Municipal Corporations (MCs), which combine all Municipal Committee functions with enhanced fiscal powers. These corporations can levy property taxes (Section 11(3)) and undertake strategic infrastructure projects such as city-wide water supply systems and mass transit planning.

6. District Councils

In rural areas, District Councils oversee administration across Sukkur, Khairpur, and Ghotki districts. As the primary land use authorities for rural territories, they prepare district-wide spatial plans (Section 15(1)(b)) and classify land for agricultural or industrial use. Their service delivery mandate includes maintaining rural road networks, irrigation systems, and solid waste management in non-municipal areas.

14.3.2 Other Agencies/ Departments

Other agencies/ departments which will be involved in the implementation of the strategic development plan are as follow:

Sr. No.	Sectors	Agency /Department Involved	Role in Implementation	Cross-Reference of Agency/Department
1.	**Housing and Urban Development**	Sindh Local Government Department	• Coordinates municipal services (water, sanitation) • Supervises MCs/UCs	• DURP&SP, SHTPA, SBCA, SKAA, SEPA, SCIP, SEPCO, SSGC, PTA, MCs Leads, approves, and coordinates the entire master planning process.
		Directorate of Urban Policy and Strategic Planning (DUR&SP) - SLGD	• Urban policy development • Strategic spatial planning and implementation • Inter-Agency coordination	• SLGD, SHTPA, SBCA, SEPA, PDMA, Mass Transit, MCs work to designs the master plan,
		Sindh Housing and Town Planning Authority (SHTPA)	• Oversees affordable housing projects • Regulates planned urban expansion	• DURP&SP, SLGD, MCs, Utilities (Gas, Electricity, Telecom), SEPA supports in urban growth management.
		Sindh Building Control Authority	• Approves building designs • Enforces	• SHTPA, DURP&SP, MCs, SEPA Ensures building bylaws and

Sr. No.	Sectors	Agency /Department Involved	Role in Implementation	Cross-Reference of Agency/Department
		(SBCA)	construction bylaws	safety regulations applied within the master plan framework.
		Sindh Katchi Abadis Authority (SKAA)	• Slum regularization • Infrastructure upgradation and social development	• SHTPA, DURP&SP, SLGD, MCs, Social Welfare Identifies informal settlements to integrate them into master planning
2.	**Social Infrastructure**	Sindh Education and Literacy Department	• Builds new schools/colleges • Upgrades vocational training centres	• SLGD, DURP&SP, SHTPA, PDMA, MCs Identifies need of education and its infrastructure.
		Sindh Health Department	• Constructs rural health centres • Upgrades DHQ/ THQ Hospitals (e.g., DHQ Khairpur, THQ Ghotki, THQ Rohri, etc.)	• SLGD, DURP&SP, SHTPA, PDMA, MCs help to Identifies land for health facilities.
		Sindh Social Welfare Department	• Establishes orphanages/ women's shelters • Runs poverty alleviation programs	• MCs, SLGD, SHTPA, SKAA help to make plans for social welfare facilities
		Municipal Committees (MCs)	• Prepare/enforce zoning and master plans (Sec. 12(2)(a)). • Regulate private housing schemes. • Building control and commercial licensing	• Key local body that implements zoning, building control, and infrastructure delivery
3.	**Transportation**	Sindh Mass Transit Authority	• Improved Khairpur's transport by developing bus routes/terminals, for urban mobility connectivity.	• SLGD, DURP&SP, MCs Plans transportation routes in master planning.

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Sr. No.	Sectors	Agency /Department Involved	Role in Implementation	Cross-Reference of Agency/Department
5.	**Environment and Disaster**	Sindh Environmental Protection Agency	• Monitors pollution, enforces environmental laws and public health protection.	• SLGD, DURP&SP, Mass Transit, PDMA, MCs, provides environmental guidelines, approves EIAs, in master planning.
		Provincial Disaster Management Authority	• Disaster preparedness, risk reduction, and resilience building for emergency situations.	• SEPA, Health, Education, and MCs help ensure that disaster risk management and resilience are integrated into master planning.
6.	**WATSAN**	Sindh Cities Improvement Program	• Improves water supply, sanitation, and municipal services.	• Work with SLGD, MCs, WATSAN in urban improvement projects
7.	**Solid Waste Management**	Sindh Cities Improvement Program	• Improves SWM through better collection, disposal, sanitation, and municipal capacity building.	• Work with SLGD, MCs, solid waste management in urban improvement projects
8.	**Electricity**	Sukkur Electric Power Company	• Supplies electricity, maintains distribution network, and ensures power availability.	• SLGD, MCs, DURP&SP, SHTPA provide plans for gas network extensions.
9.	**Sui gas**	Sui Southern Gas Company	• Supplies natural gas, maintains pipelines, and ensures safe distribution.	• SLGD, MCs, SHTPA work in a plan for a gas network planning for urban expansion and master planning.
10.	**Telecommuni-cation**	Pakistan Telecommunication Authority	• Telecom services/ensures quality, and digital connectivity.	• SLGD, MCs, DURP&SP work for telecom and digital infrastructure in projects.

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14.4 Legal and Regulatory Framework

Local governance agencies responsible for handling development proposals must ensure that all activities related to development and their approval processes are conducted in strict compliance with the urban planning statutory frameworks established by the Government of Pakistan at all levels. This includes adherence to the legal provisions outlined in the relevant articles of the Constitution of Pakistan and the primary legislation governing land acquisition and compensation, specifically the Land Acquisition Act (LAA) of 1984.

14.4.1 National Level Policy Frameworks

The Constitution of the Islamic Republic of Pakistan, passed on April 10, 1973, and amended thereafter, serves as the supreme legal authority for all national and provincial laws. The Constitution legally validates planning-related legislation, particularly those related to land acquisition and compensation. The Land Acquisition Act, 1894 (LAA) remains the primary legislation governing the compulsory acquisition of land and related compensation for public sector projects across the country.

14.4.2 Provincial and Statutory Planning Frameworks (Sindh Level)

After the 18th Constitutional Amendment, the Government of Sindh assumed full legislative authority over urban planning, environment, and local governance. The Sindh Local Government Act (SLGA) 2013 governs municipal operations and urban development responsibilities in Sukkur Division. Planning and building control are managed under the Sindh Building Control Ordinance, 1979, which was extended to the entire province via notification on 14th February 2011, transforming the Karachi Building Control Authority into the Sindh Building Control Authority (SBCA). SBCA now operates across five regional offices; Karachi, Hyderabad, Mirpur Khas, Sukkur, and Larkana with Sukkur Division falling under the Sukkur Regional Office.

14.4.3 Land Management and Informal Settlements

Land administration and ownership are governed by the Sindh Land Revenue Act, 1967 and the Sindh Colonization of Government Lands Act, 1912, both of which guide classification, leasing, and taxation of land. Informal settlements in urban areas are addressed under the Sindh Katchi Abadis Authority Act, 1987, which provides mechanisms for regularization and integration into formal planning frameworks.

14.4.4 Environmental and Climate Regulation

All development projects in Sukkur are subject to environmental clearance under the Sindh Environmental Protection Act, 2014, which mandates Initial Environmental Examinations (IEE) or Environmental Impact Assessments (EIA). These are overseen by the Sindh Environmental Protection Agency (EPA

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Sindh), operating regionally to ensure compliance with the National Environmental Quality Standards (NEQS). Additionally, the Sindh Climate Change Policy (2022) provides strategic direction for climate adaptation and mitigation in vulnerable districts like Sukkur, Khairpur, etc.

14.4.5 Urban Infrastructure and Service Provision

To improve urban service delivery, the Sindh Cities Improvement Program (SCIP) supports water supply, sanitation, and solid waste management in secondary cities, including Sukkur. Development initiatives must also align with the Sindh Mass Transit Authority Act (2014) and Sindh High Density Development Board Act (2014), which provide guidance on transit planning and vertical urban growth.

14.4.6 Disaster Risk Management

The Sindh Disaster Management Act, 2010 established the Provincial Disaster Management Authority (PDMA Sindh), responsible for disaster risk reduction, emergency preparedness, and post-disaster recovery. This is crucial for Sukkur Division, which is prone to flooding and climate-related vulnerabilities.

14.5 Delivering the Necessary Physical and Social Infrastructure Recommendations

14.5.1 Political Hindrance to Optimal Infrastructure Delivery

In the context of Sukkur Division, the delivery of physical and social infrastructure remains hindered by political interference and prioritization that often does not align with on-ground needs. Despite the presence of local government institutions across cities like Khairpur, Ghotki, Mirpur Mathelo and Rohri infrastructure projects are frequently allocated based on political influence rather than objective assessments of service gaps or urban growth patterns.

Feedback received during the consultations for various planning initiatives including the preparation of local and regional master plans highlighted concerns that development in the division is dictated by political expediency. In some instances, projects are allocated to specific union councils or neighbourhoods due to political affiliations rather than actual need, leading to unbalanced development and neglect of peripheral or less-connected areas.

To address these imbalances, the capacity of local governments in cities like Khairpur, Ghotki, Mirpur Mathelo and Rohri must be strengthened, particularly in the areas of technical proposal development, project justification, and resource mobilization. A collaborative approach between neighbouring municipalities such as Sukkur-Rohri, Ghotki-Adilpur and Khairpur-Therhi can enhance the financial and operational feasibility of large-scale projects.

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Active engagement with civil society, community-based organizations, and citizen groups must also be encouraged during the planning and prioritization phases. Local residents often have the most accurate understanding of service deficiencies, and their inclusion in decision-making processes can help depoliticize project selection and refocus development on public need. Elected representatives have a duty to uphold the integrity of the planning system. To promote good governance, they should:

- Refrain from supporting land use or infrastructure schemes that contradict approved master plans or violate zoning regulations.
- Avoid lobbying for projects that benefit specific individuals or groups to the detriment of the broader community.
- Disclose interactions with developers, contractors, or investors related to public projects.
- Participate in capacity-building sessions to understand planning systems and strategic goals.

Be subject to a Planning Code of Conduct, specifically drafted for local governments in Sukkur Division by the Sindh Local Government Department. This document should be publicly accessible to promote transparency and accountability. As part of the implementation framework for future plans in Sukkur Division, elected officials should be formally briefed on the strategic vision and development priorities to ensure their support for coordinated and evidence-based infrastructure development.

14.5.2 Staffing of Local Governments and Agencies

A major institutional challenge identified during planning engagements across Sukkur Division is the frequent rotation and relocation of public sector staff, particularly within municipal administrations, planning departments, and line agencies such as Public Health Engineering and Works and Services. In cities like Ghotki, Khairpur, Mirpur Mathelo and Rohri, technical officers are often posted for short periods sometimes less than two years before being transferred, often to posts in larger cities such as Sukkur or Hyderabad.

This rotation policy weakens institutional memory, disrupts project continuity, and prevents the establishment of trust with local communities. Many staff members are reluctant to relocate to rural tehsils or underdeveloped towns and treat such postings as temporary, contributing to poor service delivery and weak administrative ownership. Projects initiated by one team may be stalled, re-evaluated, or deprioritized by incoming personnel who lack understanding of local contexts. In Khairpur district, for example, several infrastructure initiatives have faced delays due to a lack of continuity in project oversight. To improve institutional effectiveness, it is recommended that:

- The provincial government review and reform staff rotation policies, particularly for critical posts within local governments and development authorities.
- Officers posted in cities of Sukkur Division be retained for a minimum of 3–5 years, especially those overseeing planning, engineering, or municipal services.
- Incentives such as housing, transport, and hardship allowances be offered to encourage professionals to stay longer in less-developed towns.

14.5.3 Institutional Framework for Plan Implementation and Infrastructure Delivery

To transition the Development Master Plan from a strategic document to tangible outcomes, a clear institutional structure is required. This framework establishes a high-level steering committee for oversight and a technical forum for operational coordination, ensuring integrated planning, implementation, and monitoring.

A. Implementation Committee

As the apex body for the Master Plan's execution, the Implementation Committee will provide strategic direction, secure inter-departmental cooperation, and ensure accountability. Its establishment formalizes the governance structure for the plan, as notified by the Directorate of Urban Research, Policy and Strategic Planning (DURP&SP).

For the effective execution, oversight, and long-term monitoring of the Development Master Plan, a dedicated body titled the "Implementation Committee" shall be established. This committee will be responsible for the overall coordination, implementation, and monitoring of the Master Plan's objectives to guide future urban growth.

1. Team Composition

The composition of the committee shall be as follows:

- Commissioner Sukkur
- Deputy Commissioner Khairpur
- Municipal Committee Chairman
- Director Sindh Building Control Authority (SBCA), as Secretary
- Assistant Commissioner
- Representative of Directorate of Urban Research Policy and Strategic Planning (DURPSP)
- Executive Engineer Public Health Engineering (PHE)
- Representative of Government & Housing Town Planning (LG&HTP)

In addition, the heads of other relevant line departments shall be included as members or may be invited to participate in meetings when necessary to address specific agenda items.

2. Terms of Reference (TORs)

- Provide overall policy guidance and ensure adherence to the Master Plan's objectives during implementation.
- Review and approve annual implementation plans, and prioritize major projects based on strategic alignment and available resources.
- Champion and explore funding avenues, including public sector allocations, donor agencies, and Public–Private Partnerships (PPPs).
- Arbitrate and resolve high-level inter-departmental and jurisdictional conflicts that cannot be settled at the technical level.
- Receive and review quarterly progress reports from the proposed District Infrastructure Coordination Forum (DICF) and the Secretary, tracking key performance indicators against established targets.
- Ensure a structured mechanism for stakeholder consultation by mandating and reviewing outcomes from public forums and expert input sessions.

B. District Infrastructure Coordination Forum (DICF-Khairpur): The Technical Arm

Supporting the projected population growth and remedying current infrastructure deficiencies requires breaking down institutional silos. Currently, municipalities, utility providers, and sectoral departments function in isolation, leading to fragmented development and duplication of efforts (e.g., housing schemes installing utilities without alignment, or health departments building facilities without consulting on road access).

The DICF-Khairpur is established as the primary technical coordination body, which will report directly to the Implementation Committee.

1. Composition & Chair

- Chairperson: Deputy Commissioner Khairpur
- Secretariat Support: Regional Office of the Sindh Local Government Department.
- Members:
  - Chief Officers, Planning Officers, and Engineers of all Municipal Committees in the district.
  - Representatives from Public Health Engineering, Education, Health, and Communication & Works Departments.
  - Executives from SEPCO, SSGC, WASA Khairpur, and other utility providers.
  - Representative from the Sindh Human Settlement Department.
  - Civil society observers and private sector stakeholders (e.g., chamber of commerce, housing developers).

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2. Key Functions of DICF

- Ensure all infrastructure projects are aligned with the approved Master Plans and spatial strategies.
- Resolve technical-level conflicts and prevent duplication of investments by facilitating information sharing.
- Track project progress and troubleshoot implementation bottlenecks, escalating unresolvable issues to the Implementation Committee.
- Review technical capacity needs of local staff and recommend targeted training programs, to be supported by provincial agencies.

C. Capacity Building and Administrative Support

For this framework to function effectively, underlying administrative challenges must be addressed:

- Each participating local government shall conduct an internal assessment of staff capabilities in urban planning, engineering, GIS, and financial management. A targeted capacity-building program will be initiated based on the identified gaps.
- The staff rotation policy must be re-evaluated to ensure key personnel are retained for longer durations, enabling them to build institutional knowledge and see projects through to completion.

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14.6 Implementation Schedule

14.6.1 Implementation Schedule for Housing Sector

Strategies	Programs/ Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Katchi Abadi Upgradation	• Under-ground drainage Water points • Paving streets and walkways	Settlement Mapping Community Engagement Plans	Human Settlement Authority (HSA), Local Government, NGOs	Short to Medium Term (1–10 years)
Infill Development	• Mixed low-rise housing in core urban areas • GIS-based vacant plot identification	Detailed Urban Plan Design Charrettes Housing Demand Analysis	Public-Private Partnerships, Local Developers	Short Term (1–3 years)
Low-Income Housing Site	• 3,500 units in 65 ha with roads, utilities, green areas	Land Suitability Analysis Environmental Assessment	Government of Sindh, Municipal Committee, Housing Agencies	Phased: Phase I–III (1–5 years)

14.6.2 Implementation Schedule for Education Sector

Strategies	Programs/ Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Infrastructure Improvement	• Rehabilitate 18 priority schools • Add classrooms, labs, libraries • Water, sanitation, electricity	School Site Planning, Needs Assessment, Survey, Budgeting	Education Works and Services Dept., Sindh Government, NGOs	Short Term (1–5 years)

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Strategies	Programs/ Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Capacity Building	• Teacher training programs • ICT integration • Smart classroom initiatives	Curriculum Update, Digital Tools Design	SEMIS, STEVTA, NGOs, Teacher Associations	Ongoing (Short to Long Term)
Access Enhancement	• New schools in underserved zones (e.g. Anwarabad) • Transport support for rural areas	Land Suitability Mapping, Enrolment Campaigns	Local Government, Sindh, Education Dept., Private Sector	Medium to Long Term (5–20 years)
Vocational and Inclusive Education	• Skill training centres • Financial aid programs • Special education for disabled	Vocational Policy Framework, Equity Strategy	TVET Institutes, NGOs, Local Govt	Medium Term (3–10 years)

14.6.3 Implementation Schedule for Health Sector

Strategies	Programs/ Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Healthcare Facility Upgradation	• Rehabilitate DHQ Hospital • Secure facility, diagnostic lab	Health Needs Assessment Infrastructure Master Plan Environmental Health Assessment	District Health Dept., PHED, Local Govt, NGOs	Immediate to Short Term (1–5 yrs)
Expanded Access	• New BHUs and RHCs • Mobile Health Units • Tele-medicine	Land Suitability Analysis Service Coverage Mapping	Sindh Health Dept., Private Sector, NGOs	Medium to Long Term (5–20 years)

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Strategies	Programs/ Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Quality and Capacity Building	• Staff accommo-dation • Training for doctors and paramedics • Equipment provision	Workforce Strategy Public Health Outreach Plan	Government Hospitals, NGOs, Medical Colleges	Ongoing
Community Health Outreach	• Hygiene and vaccination drives • Disease control campaigns	Health Awareness Strategy Monitoring Metrics	Local Health Units, CBOs, Media Campaigns	Short to Medium Term (1–10 years)

14.6.4 Implementation Schedule for Parks/Recreation Sector

Strategies	Programs/ Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Equitable Access to Parks	• New parks in underserved areas • Mohalla-level green spaces	Green Space Suitability Mapping Public Consultations	Sindh Local Government Dept., Municipal Committee, NGOs	Short Term (1–5 years)
Upgradation of Existing Parks	• Landscaping, lighting, walkways, toilets, water facilities	Park Improvement Design Plans	Parks and Horticulture Authority, Private Sector	Short to Medium Term (1–10 years)
Promotion of Sports and Fitness	• Sports complexes • Outdoor gyms • Traditional games promotion	Sports Facility Master Plan Cultural Event Calendar	Sindh Sports Board, Local Government, Community Organizations	Medium to Long Term (5–20 years)
Smart and Sustainable Parks	• ICT monitoring systems • Urban forestry • Rainwater harvesting	Sustainability Plan Urban Forest Strategy	Local Government, Environmental Protection Agencies, IT Partners	Long Term (10–20 years)

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14.6.5 Implementation Schedule for Transportation Sector

Strategies	Programs/ Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Rehabilitation of existing road network	• Resurfacing of existing roads. • Reconstruction of roads in poor condition • Construction of side shoulders and installation of roadside drainage • Clearance of encroachments	Road condition survey, Traffic survey, Geotechnical investigation.	Sindh Local Government Dept., Municipal Committee, highway division.	Short Term (1–5 years)
Upgradation and addition of new road links	• Construction of new road links. • Provision of footpaths • Improvement of road-side infrastructure	Traffic survey, Alternate route study, Available ROW and adjacent landuse survey.	Sindh Local Government Dept., Municipal Committee, highway division.	Short to Medium Term (1–10 years)
Road connectivity to the future expansions	• Existing links to be extended • Upgradation of existing small earthen road. • Provision of road safety features	Available ROW and adjacent landuse survey, Traffic survey, Geotechnical investigation.	Sindh Local Government Dept., Municipal Committee, highway division.	Medium to Long Term (5–20 years)

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14.6.6 Implementation Schedule for Water Supply Sector

Strategies	Programs/Policies	Responsibilities to Plan Implementation	Responsibilities	Time of Implementation
Water Supply Network Development	• Development of water distribution network in unserved areas • Replacement of old/leaking pipelines • Installation of new transmission mains	Hydraulic modelling, survey & mapping, network design, BOQs and cost estimates	PHED, Municipal Committee, Local Government Dept., Consultants	Short to Medium Term (1–10 years)
Source Development & Tube Wells	• Installation of new tubewells • Rehabilitation of existing tubewells • Provision of pumping machinery	Hydrogeological assessment, site selection, drilling design, procurement planning	PHED, Local Government, Irrigation Dept., Private Contractors	Short Term (1–5 years)
Overhead Reservoirs (OHRs) Development	• Construction of new OHRs • Capacity enhancement for future demand	Feasibility studies, reservoir sizing, structural design, land identification	PHED, Municipal Committee, Sindh Govt., Consultants	Medium Term (5–10 years)
Water Quality Improvement	• Installation of chlorination systems • Provision of filtration/treatment units • Water quality monitoring mechanism	Water quality assessment, treatment process design, laboratory planning	PHED, Health Dept., Environmental Protection Agency, Local Govt.	Short to Medium Term (1–10 years)
Metering and Demand Management	• Installation of consumer water meters • Reduction of non-revenue water (NRW) • Awareness campaigns for	NRW assessment, metering policy framework, tariff planning, community engagement	Municipal Committee, PHED, Local Government, NGOs	Medium Term (3–10 years)

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Strategies	Programs/Policies	Responsibilities to Plan Implementation	Responsibilities	Time of Implementation
	water conservation			
Operation & Maintenance Strengthening	• O&M staff capacity building • Provision of repair equipment • Routine maintenance schedules	Training plans, O&M manuals, procurement of maintenance tools	Municipal Committee, PHED, Local Govt.	Ongoing (Short to Long Term)

14.6.7 Implementation Schedule for Sewerage/ Drainage Sector

Strategies	Programs/Policies	Responsibilities to Plan Implementation	Responsibilities	Time of Implementation
Sewerage Network Development	• Construction of sewer lines in unserved areas • Rehabilitation of damaged sewers • Replacement of undersized/choked pipes	Sewerage survey, hydraulic design, network mapping, preparation of BOQs	PHED, Municipal Committee, Consultants	Short to Medium Term (1–10 years)
Trunk Sewer and Main Collectors	• Development of trunk sewer system • Strengthening of main disposal network	Feasibility studies, route alignment, detailed design, land acquisition planning	PHED, Local Government Dept., Municipal Committee	Medium to Long Term (5–20 years)
Pumping/Lift Stations Development	• Construction of lift stations • Upgradation of disposal pumping stations • Provision of electro-mechanical equipment	Site selection, design of pumping stations, equipment procurement plans	PHED, Municipal Committee, Private Contractors	Medium Term (3–10 years)

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Strategies	Programs/Policies	Responsibilities to Plan Implementation	Responsibilities	Time of Implementation
Wastewater Treatment & Safe Disposal	• Construction of wastewater treatment plant (WWTP) • Provision of safe disposal mechanism	Environmental assessment, WWTP feasibility, treatment design, approvals	PHED, EPA Sindh, Sindh Govt., Local Govt.	Medium to Long Term (5–20 years)
Sewerage O&M and Cleaning System	• Procurement of jetting/suction machines • Routine cleaning schedules • Strengthening complaint response mechanism	O&M planning, equipment procurement, staffing and training	Municipal Committee, PHED, Local Government	Short Term (1–5 years)
Industrial Wastewater Control	• Regulation for industrial discharge • Mandatory pre-treatment for industries before sewer connection	Policy framework, enforcement mechanism, monitoring system	EPA Sindh, Industries Dept., Municipal Committee	Medium Term (5–10 years)
Community Awareness & Public Hygiene	• Public awareness campaigns on sewer misuse • Cleanliness and hygiene promotion	IEC material development, outreach programs, coordination with communities	Local Govt., Health Dept., NGOs	Ongoing (Short to Long Term)

14.6.8 Implementation Schedule for Telecommunication Sector

Strategies	Programs/Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Infrastructure Mapping and Pilot Expansion	• GIS-based mapping of PTCL/mobile infrastructure • Landline expansion in high-gap areas • Pilot digital literacy	Telecom Audits Stakeholder Consultations	PTCL, Telecom Regulators (e.g., PTA), Local Governments	Short Term (1–3 years)

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Strategies	Programs/Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
	sessions in schools/community centres			
Broadband and Public Wi-Fi Deployment	• Fiber-optic rollout in high-density zones • 10+ public Wi-Fi hotspots in CBDs/public buildings • Subsidized broadband packages for low-income households	Feasibility Studies Public-Private Partnership Frameworks	Telecom Companies (e.g., Jazz, Telenor), Municipal Authorities	Medium Term (5 – 10 years)
Universal Connectivity and Smart Integration	• 100% landline/broadband coverage • Smart poles and IoT network integration • E-governance digitization	Smart City Master Plans Regulatory Adjustments	Federal IT Ministry, Private Tech Firms	Medium to Long Term (10–16 years)

14.6.9 Implementation Schedule for Power Sector

Strategies	Programs/Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Grid Modernization	• Installation of additional transformers at key locations. • Smart meter deployment • Basic monitoring	Load Analysis Pilot Project Feasibility Studies	SEPCO, Local Government, Private Contractors	Short Term (1-3 years)

Strategies	Programs/Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
	systems for grid management			
Renewable Energy Expansion	• Pilot solar energy projects in residential areas • Utility-scale solar farm development • Energy storage solutions	Solar Potential Mapping Regulatory Approvals	Energy Department, Private Investors, Renewable Energy Firms	Medium Term (5 - 10 years)
Transmission and Distribution Upgrade	• Critical network upgrades to reduce losses • New transmission lines installation • Smart grid full deployment	Infrastructure Assessment Cost-Benefit Analysis	National Transmission Company, Engineering Firms, Government	Medium to Long Term (5-16 years)
Universal Access and Resilience	• Extend electricity to underserved areas • Grid protection against environmental disruptions • Advanced automation and real-time monitoring	Equity Mapping Disaster Risk Planning	Federal Energy Agencies, Local Authorities, NGOs	Long Term (10-16 years)

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14.6.10 Implementation Schedule for Gas Sector

Strategies	Programs/Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Infrastructure Assessment and Initial Expansion	• Technical audit of existing gas network • Expansion to non-Sui gas areas • Installation of 1 TBS • Awareness campaigns in 3 underserved communities	Infrastructure capacity analysis Community needs assessment	SNGPL/SSGC, Local government bodies, Community organizations	Short Term (1-3 years)
Network Modernization and Expansion	• 100% suburban coverage • Smart metering implementation • Mobile service units for safety/connections • Pipeline replacement program initiation	GIS mapping of network Regulatory approvals Safety protocol development	Gas utility companies, Engineering contractors, Safety regulators	Medium Term (5 - 10 years)
System Optimization and Digital Transformation	• Winter load shedding reduction (<1hr/day) • Predictive maintenance systems • Complete pipeline replacement	Advanced analytics planning Disaster resilience strategy Digital integration framework	Federal energy ministry, Technology partners	Medium to Long Term (10-16 years)

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14.6.11 Implementation Schedule for Disaster Management Plan

Strategies (All Hazards)	Programs / Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
• **Multi-Hazard Risk Assessment & Mapping (Floods, Earthquake, Drought)** • **Early Warning Systems (Floods, Heatwave, Drought)** • **Emergency Preparedness & Evacuation Planning (Floods, Earthquake, Fire, Crowds)** • **Health & Livelihood Protection (Heatwave, Drought, Flood)**	• Union Council-level risk mapping & floodplain zoning • Install river gauges, weather stations & SMS alert systems • Identify shelters, cooling centers, and safe gathering areas • Fire alarms, detectors, evacuation drills in schools/offices • Vaccination & fodder programs for livestock during drought • Train volunteers in first aid & rescue	• Prepare hazard maps & GIS databases • Design alert protocols & SOPs (SMS, mosque loudspeakers, media) • Draft evacuation & shelter management plans • Develop fire & crowd safety training modules • Prepare community outreach campaigns	• Lead Departments: PDMA Sindh, Irrigation Dept., PMD, SBCA, Rescue 1122, Local Govts. • Support Departments: Education Dept., Health Dept., NGOs, Telecom Operators, SUPARCO, Police Dept., Social Welfare Dept.	Immediate to Short Term (1–3 years)
• **Infrastructure & Engineering Resilience (Flood, Urban Flood, Fire)** • **Agricultural & Water Management (Drought)** • **Awareness & Capacity Building (All Hazards)** • **Recovery &**	• Strengthen embankments, bunds, drainage & stormwater systems • Rainwater harvesting, conjunctive water use, tank renovation • Introduce drought-resistant crops & seed banks	• Conduct hydrological & structural surveys • Prepare engineering designs & cost estimates • Develop agriculture subsidy/credit schemes • Prepare awareness/IEC	• Lead Departments: Irrigation Dept., P&D Dept., Agriculture Dept., SBCA, Local Govt. Depts. • Support Departments: Works & Services Dept., Health Dept.,	Medium Term (5–10 years)

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Strategies (All Hazards)	Programs / Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
Rehabilitation (Flood, Drought, Earthquake, Fire)	• Retrofit priority public buildings for earthquake/fire safety • Annual hazard drills and volunteer training • Post-disaster needs assessments & restoration of infrastructure	materials & drill schedules • Draft PDNA templates & beneficiary targeting criteria	Environment Dept., NGOs, CBOs, Social Welfare Dept.	
• **Institutional Coordination & Policy Strengthening (All Hazards)** • **Integrated Disaster Management Frameworks**	• Strengthen coordination among PDMA, DDMA, line departments & NGOs • Integrate disaster management into district master plans & budgets • Establish multi-hazard emergency operations centers	• Draft TORs & coordination frameworks • Schedule quarterly multi-agency meetings • Allocate fixed budget share for resilience projects	• Lead Departments: PDMA Sindh, DDMA, Local Govts. • Support Departments: Health Dept., Education Dept., NGOs, Municipal Authorities, P&D Dept.	Medium to Long Term (5–16 years)
• **Long-Term Mitigation & Resilience (Floods, Urban Flood, Heatwave, Drought, Earthquake, Fire, Crowds)** • **Environmental & Social Safeguards**	• Promote flood-resilient construction, earthquake-resistant building codes, heat-resilient design • Expand urban green cover, watershed management, afforestation • Develop water resource information systems &	• Draft and enforce long-term building/planning codes • Launch large-scale afforestation & green infrastructure projects • Establish research-data partnerships with universities	• Lead Departments: Sindh Environment Dept., Urban Planning Depts., Irrigation Dept., P&D Dept. • Support Departments: Forest Dept., Research Institutes, Local	Long Term (10–16 years)

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Strategies (All Hazards)	Programs / Policies	Responsibilities to Plan	Implementation Responsibilities	Time of Implementation
	drought research • Institutionalize psychosocial care & recovery systems • Transparent post-disaster communication & incident reporting	• Develop post-disaster M&E and knowledge-sharing frameworks	Govts., NGOs, Municipal Committees	

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ANNEXURES

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ANNEXURE - 1: VISION WORKSHOP – MINUTES OF MEETING

DIRECTORATE OF URBAN REGIONAL POLICY & STRATEGIC PLANNING
PLANNING & DEVELOPMENT DEPARTMENT
GOVERNMENT OF SINDH

MINUTES OF MEETING

Stakeholder Consultation & Future Vision Development Workshop - Khairpur City

Project: Preparation of Development Master Plans for Twelve (12) Major Secondary Cities of Sindh (Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)

Date: 30-04-2024 (Tuesday)

Location: Darbar Hall DC Office, Khairpur

Chaired By: Deputy Commissioner Khairpur Mr. Syed Ahmad Fawad

Subject: Stakeholder Consultation and Future Visioning Workshop

Agenda of Workshop

The team conducted the future vision development workshop with stakeholders from various line departments as mentioned in the below table. The meeting was attended by the representative from Directorate of Urban Regional Policy & Strategic Planning, Planning & Development Department and Asian Consulting Engineers. Detailed list of attendees is attached in Annexure.

From Client	From Consultant	Line Departments
Mr. Zulfiqar Ali Mr. Muhammad Soomar Mr. Ali Murad Abro	Mr. Ali Akbar Daudpota Dr. Ahsan Iqbal Mr. Shehroz Khan Mr. Faizan Ahmad Mr. Umair Khalid Mr. Majid Rehman Mr. Ammar Iqbal Mr. Muhammad Abbas Mr. Muhammad Ammar Asghar Mr. Saim Ahmed Khan	District Council Khairpur, Municipal Committee Khairpur, Medical Emergency Resilience Foundation (MERF), Anjman-e-Tajraan, Qatar Charity, Indus Resource Centre (IRC), Community World Service Asia, Management & Development Foundation, Strengthening Participatory Organization (SPO), Public Health Engineering Division (PHED), Khairpur Women Association, PPHI Khairpur, Mukhtarkar Khairpur, Education Department, Health Department, Shifa Foundation and Taj Pump.

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Introduction and Welcome

The meeting began with a cordial welcome extended to all participants by the DC Khairpur, who outlined the project's significance and necessity, expressing keen interest in the success of the development master plan. Following this, the Deputy Director (Housing) of URP&SP introduced the overall mandate of the directorate and consulting firm, providing details about the project and highlighting the firm's expertise in such endeavours, while also expressing confidence in Asian Consulting Engineers.

Overview of Workshop

Dr. Ahsan Iqbal, representing Asian Consulting Engineers, took charge and provided an insightful overview of the project to the attendees. He outlined the project's framework, methodology, current progress, and upcoming activities. Additionally, he presented the Khairpur city's current state based on situational analysis, covering various sectors within the project's scope, such as urban planning (including housing, healthcare, education, parks, and open spaces), transportation system, environmental analysis, disaster risk management, solid waste management, water & sanitation, power, telecommunication & gas and the urban & regional economy. Furthermore, he emphasized the importance of conducting a future vision development workshop in development master plan by explaining the workshop's purpose and the activities planned.

Discussion Session

DC Khairpur commended the overall progress of the project and requested all the stakeholders to provide feedback to the consultant team on the existing situation of the city. The following points were highlighted by the stakeholders from the line departments:

DC Khairpur emphasized the importance of assessing the relevant departments' capacity to ensure they can successfully execute and manage the proposed projects. He also stressed the need to enhance transparency and responsiveness within the administrative structure, if necessary, to ensure effective project implementation.

In response, Dr. Ahsan Iqbal outlined a comprehensive approach for the proposal, which includes a phased plan consisting of long-term, short-term, and immediate action plan to guide project implementation. Additionally, he mentioned that an implementation strategy will be proposed to ensure transparent and effective execution of the development master plan. He also highlighted that public workshops were conducted as part of the master plan exercise to engage the general public and gather their suggestions and recommendations. Ultimately, the project aims to enhance the Human Development Index (HDI) of the citizens.

Stakeholders also raised concern about the migration trend from neighbouring villages to Khairpur, which is exerting pressure on the city's infrastructure. He sought clarification on how the consultant intends to address this issue.

Dr. Ahsan Iqbal responded by emphasizing the importance of providing essential infrastructure facilities in nearby settlements. This approach aims to manage migration and foster the development of self-sustaining towns.

Mr. Khadim Mirani expressed concern regarding the approval of unplanned housing schemes, raising questions about the fairness of the approval process.

Dr. Ahsan Iqbal addressed this by highlighting that certain housing scheme layouts identified during the situational analysis phase are vacant till now. He emphasized the importance of a transparent approval system for housing schemes and encouraged that it should be according to the need of the population to ensure controlled conversion of agricultural land to urban areas.

Rukhsana Mubarak (Project Manager ACF) recommended that the consultant should incorporate the ongoing projects like the Green Sindh Initiative into the city's master planning exercise. He also suggested considering proposals for the introduction of electric vehicles, in line with the objectives of the Green Sindh Initiative. Additionally, he emphasized the importance of conducting thorough research before implementing any tree plantation initiatives. For example, recent tree plantations along roads resulted in respiratory issues, such as an increase in asthma cases among residents.

It is also highlighted that there is a need for additional parks and open spaces within the city, noting that existing ones suffer from insufficient maintenance. He suggested that the consultant should provide recommendations on how to effectively maintain these recreational areas.

Dr. Ahsan Iqbal responded by stating that the rehabilitation, improvement, and future expansion of the parks and open spaces will adhere to the standards. He assured that detailed plans for these enhancements will be presented in the forthcoming stages of the project.

Ms. Khalida Riaz (Khairpur Women Association) suggested that the healthcare facilities should be improved according to the standards. She further highlighted that the consultant team should devise a strategy to enhance the current condition of the graveyards and recommend suitable locations for the future ones.

Dr. Yar Muhammad (Chairman MC Khairpur) pointed out that the current dumping site has reached to its full capacity and has been closed. He emphasized the necessity of establishing a landfill site for future waste disposal needs. Furthermore, he added that the water quality of the current sources needs to be assessed to determine its suitability for drinking and other purposes.

Dr. Ahsan Iqbal responded that the proposal for the landfill site is planned in the upcoming stages, however, the water quality of the city from different sources has been tested and it is in non-compliance with the standards.

Mr. Ghulam Rasool (Municipal Engineer MC Khairpur) suggested that considering the existing water quality of the city there is a need of a water treatment plant.

Ms. Rukhsana Mubarak (Project Manager ACF) suggested that the household solid waste must be sorted out during initial collection as well and the served area of solid waste management should also be increase.

Mr. Khadim Mirani highlighted that during the urban flooding, however the officials were working but due to the limited resources the water remained in the streets for two days. Thus, there is a need to improve departmental competency and propose solutions for low-lying areas prone to flooding.

Mr. Ashike Hussain Abbasi (President Anjman-e-Tajran) stated that the date production, a vital contributor to the city's economy, should be increased through the utilization of advanced techniques and technology.

All the suggestions have been noted down by the consultant team for their incorporation in the proposals.

Future Vision Development Workshop

The meeting concluded with an engaging exercise aimed at envisioning the future vision development of Khairpur city. The consulting team distributed questionnaires and various forms to gather input from all participants. This exercise was structured into three tasks:

Task 1: "Have We Missed Anything?" This involved a mapping workshop where attendees mentally charted out aspects they felt were overlooked.

Task 2: "What Makes a City Great?" Participants engaged in discussions and documented existing challenges and suggestions for the city's future improvement.

Task 3: "What is the Future Development of Khairpur City?" Another mapping workshop focused on outlining the envisioned future of Khairpur.

Throughout this exercise, consultants diligently recorded attendees' insights regarding Khairpur's current status and its projected trajectory over the next 20 years.

The meeting concluded with expressions of gratitude exchanged between the participants and the chairperson.

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ANNEXURE - 2: VISION WORKSHOP STAKEHOLDER LOG

A. Vision Workshop – Attendance Sheet

"Preparation of Development Master Plans for
Twelve (12) Major Secondary Cities of Sindh
(Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)"

Khairpur **Attendance Sheet (SWOT Analysis & Future Vision Workshop)**

Sr No.	Name	Contact Number	Designation and Department	Signature
1.	Syed Ahmed Barad	0300-7076124	DC Khairpur	
2.	Arsalan Haider	0243-2860957	ADC-II KHP.	
3.	Zulfiqar Ali	03072525349	Dy. Director URPSP	
4.	Abdul Ghafoor Shaikh	0301 8316623	Planning Anjuman-e-Tajreen	
5.	DR. Yar Muhammad	03008315230	Chairman MC KHP	
6.	Rehana Umrani	0306 3632340	Councillor MC KHP	
7.	Fozia Mallah	0300 3102307	Councillor MC KHP	
8.	Engr. Mir Muhammad	0333-7582155	Assistant Engineer P. Building Khairpur	
9.	Abdul Razaque	0345 3580551	MEAL Officer MERF	
10.	Naimatullah Mirani	03443939018	Sr. Manager IRC	
11.	Shamsulhaque	0333-7148226	Distt Co-ordinator - MERF	
12.	Ghulam Shabir	03318907833	DPO Qalandhanty	
13.	Shah Mohammad Rajar	03013411 4983	EDE (E.Sec/H.Sec) Khairpur	
14.	Ameer Ali	03355324833	CWSA Project officer	
15.	Furqan Channa	0243-2730910	Technical Advisor MDF	
16.	Babar Mir	03047999813	Field officer MDF	

"Preparation of Development Master Plans for
Twelve (12) Major Secondary Cities of Sindh
(Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)"

Attendance Sheet (SWOT Analysis & Future Vision Workshop)

Sr No.	Name	Contact Number	Designation and Department	Signature
17.	Mehtab Channa.	0331-2746013	Program Officer SPO	
18.	Ghulam Raza Sial	0314-7560432	District Project Manager	
19.	[illegible]	03009317501	[illegible]	
20.	Ghulam Hussain Abro Memon	03013889084	TMO Distt Population Welfare	
21.	Zafar Iqbal.	0336-2722566	Addl: DC G, Khairpur.	
22.	Ali Murad Abro	03122097717	AA DSPD.	
23.	Ghulam Rasool.	0333-7358822	Municipal Engineer, Municipal Wkp	
24.	A.E. Akbar Mello	0300-3136633	XEN (PHE) KHP.	
25.	Irfan Hyder	0333-3602725	DM PPHI ICap A.	
26.	GHULAM NABI		AC KHAIRPUR.	
27.	Muhammad Bugti Abro	03008310458	EC Member EPCCI	
28.	Rukhsana Mubarak	300-9679359	Project Manager ACF	
29.	Khalida Riaz	0302-5554411.	Khairpur Women Association KWA	
30.	KHADIM MORVI	03129314605	Khadim Obsite - Project Mgr	
31.	Asiqur Rahman	03003183147	GI-S P-P-P Talukakhairpur	
32.	Syed Sajid Shah	0300-2291293	DAi - KMP	

"Preparation of Development Master Plans for
Twelve (12) Major Secondary Cities of Sindh
(Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)"

Attendance Sheet (SWOT Analysis & Future Vision Workshop)

Sr No.	Name	Contact Number	Designation and Department	Signature
33.	Waseem Gul	03007030858	P.S to DC	
34.	Ehtesham Ahmed	0301-3868934	P.S to EDC-O	
35.	A. Hakeem Dharejo	03013418883	Mukhi Kisan	
36.	A. Qadir Shaikh	0300-3115041	XEN Education Khairpur	
37.	DR Abdul Qadir Bullo	0300 2325185	DHO Khairpur	
38.	Tufail Ahmed	—	TMO	
39.	Engr. Faizan Ahmad	03214823097	Sr. Design Engg. Asian Consultant	
40.	UMAIR KHALID	03216957100	Sr. Electrical Engineer ACE	
41.	Habibullah Nangi	0306-2251651	D.P.O SKSO Khairpur	
42.	Dr. Murtaza Arisar	03337585713	RMO KMC Hospital	
43.	MR. Ashfaq Hussain Abbasi	03003112776	President Anjuman Tajran	
44.	Ghulam Muhammad Malik	0300-3145881	S. Voice. Chairman Anjuman Tajran	
45.	Shams-Ul-Rehman	0306-3666642	District coordinator - Shifa	
46.	Ab Lakeem Shaikh	03003038588	Bissnis man Taj Pump.	
47.	M. Soomro	03004171576	—	
48.	Allah Dewayo	03003102610	(DDEO) Primary Education	

"Preparation of Development Master Plans for
Twelve (12) Major Secondary Cities of Sindh
(Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)"

Attendance Sheet (SWOT Analysis & Future Vision Workshop)

Sr No.	Name	Contact Number	Designation and Department	Signature
49.	Shehroze Khan	0331-7703505	Transportation Engr. from ASIAN	
50.	Muhammad Abbas.	0304-5206118	Environmentalist, Asain consulting	
51.	M. AKHTAR ASGHAR	0334-4847567	Jr. ASIAN Engg.	
52.	Saim Ahmed Khan	0310-4650175	Jr. Transportation Engg:	
53.	Majid Rehman	0333-4300916	GIS Specialist	
54.	Dr. Ahsan Iqbal	0343-7161847	Sr. Urban Planner	
55.	Ammar Iqbal	0303-9605094	Jr. Town Planner Asian.	
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B. Vision Workshop Activities

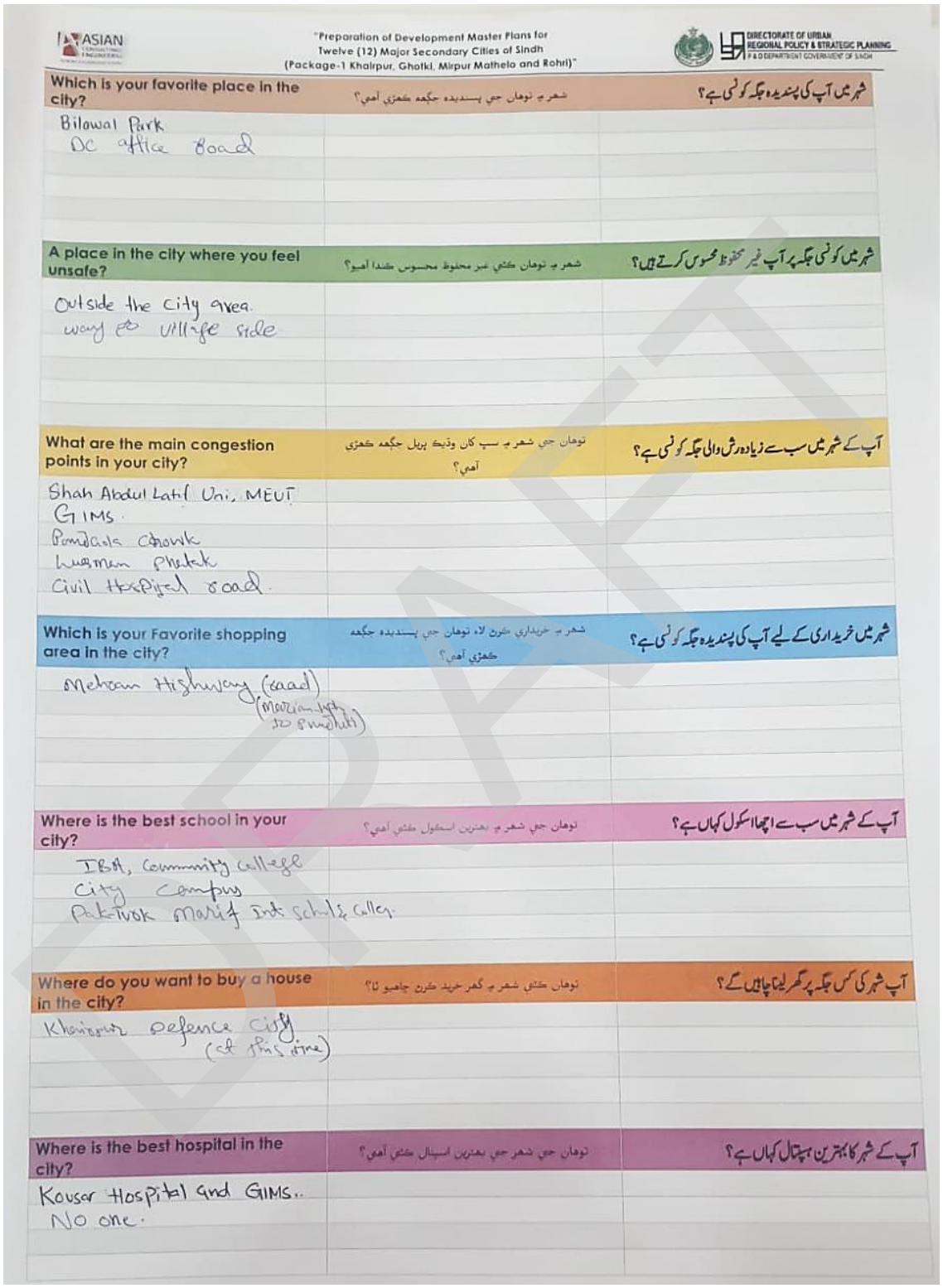
1. Session 1 - Have We Missed Anything?

"Preparation of Development Master Plans for
Twelve (12) Major Secondary Cities of Sindh
(Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)"

DIRECTORATE OF URBAN, REGIONAL POLICY & STRATEGIC PLANNING
P&D DEPARTMENT GOVERNMENT OF SINDH

Which is your favorite place in the city?	شهر ۾ توهان جي پسنديده جڳهه ڪهڙي آهي؟	شہر میں آپ کی پسندیدہ جگہ کونسی ہے؟
A place in the city where you feel unsafe?	شهر ۾ توهان کٿي غير محفوظ محسوس ڪندا آهيو؟	شہر میں کونسی جگہ پر آپ غیر محفوظ محسوس کرتے ہیں؟
What are the main congestion points in your city?	توهان جي شهر ۾ سڀ کان وڌيڪ پريل جڳهه ڪهڙي آهي؟	آپ کے شہر میں سب سے زیادہ رش والی جگہ کونسی ہے؟
Which is your Favorite shopping area in the city?	شهر ۾ خريداري ڪرڻ لاء توهان جي پسنديده جڳهه ڪهڙي آهي؟	شہر میں خریداری کے لیے آپ کی پسندیدہ جگہ کونسی ہے؟
Where is the best school in your city?	توهان جي شهر ۾ بهترين اسڪول ڪٿي آهي؟	آپ کے شہر میں سب سے اچھا اسکول کہاں ہے؟
Where do you want to buy a house in the city?	توهان ڪٿي شهر ۾ گهر خريد ڪرڻ چاهيو ٿا؟	آپ شہر کی کس جگہ پر گھر لینا چاہیں گے؟
Where is the best hospital in the city?	توهان جي شهر جي بهترين اسپتال ڪٿي آهي؟	آپ کے شہر کا بہترین ہسپتال کہاں ہے؟

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"Preparation of Development Master Plans for
Twelve (12) Major Secondary Cities of Sindh
(Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)"

DIRECTORATE OF URBAN REGIONAL POLICY & STRATEGIC PLANNING
P&D DEPARTMENT GOVERNMENT OF SINDH

Which is your favorite place in the city?	شهر ۾ توهان جي پسنديده جڳهه ڪهڙي آهي؟	شہر میں آپ کی پسندیدہ جگہ کونسی ہے؟
Bilawal Park DC office Road		
A place in the city where you feel unsafe?	شهر ۾ توهان ڪٿي غير محفوظ محسوس ڪندا آهيو؟	شہر میں کونسی جگہ پر آپ غیر محفوظ محسوس کرتے ہیں؟
Outside the city area. way to village side		
What are the main congestion points in your city?	توهان جي شهر ۾ سڀ کان وڌيڪ پريل جڳهه ڪهڙي آهي؟	آپ کے شہر میں سب سے زیادہ رش والی جگہ کونسی ہے؟
Shah Abdul Latif Uni, MEUT GIMS. Pandala Chowk Luqman Phatak Civil Hospital road.		
Which is your Favorite shopping area in the city?	شهر ۾ خريداري ڪرڻ لاءِ توهان جي پسنديده جڳهه ڪهڙي آهي؟	شہر میں خریداری کے لیے آپ کی پسندیدہ جگہ کونسی ہے؟
Mehran Highway (road) (Mazian Hyd to Mirpur Khas)		
Where is the best school in your city?	توهان جي شهر ۾ بهترين اسڪول ڪٿي آهي؟	آپ کے شہر میں سب سے اچھا اسکول کہاں ہے؟
IBA, Community college City campus Pak-Turk Maarif Int. Schools Colleges		
Where do you want to buy a house in the city?	توهان ڪٿي شهر ۾ گهر خريد ڪرڻ چاهيو ٿا؟	آپ شہر کی کس جگہ پر گھر لینا چاہیں گے؟
Khairpur Defence City (at this time)		
Where is the best hospital in the city?	توهان جي شهر جي بهترين اسپتال ڪٿي آهي؟	آپ کے شہر کا بہترین ہسپتال کہاں ہے؟
Kousar Hospital and GIMS.. No one.		

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2. Session 2 - What Makes a City Great?

"Preparation of Development Master Plans for
Twelve (12) Major Secondary Cities of Sindh
(Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)"

DIRECTORATE OF URBAN, REGIONAL POLICY & STRATEGIC PLANNING
P & D DEPARTMENT GOVERNMENT OF SINDH

City Name: _____

Department: _____

Name and Designation: _____

1. **What sectors do you think are supporting city's economy? Rate from 1-5, with 1 being the highest, and strongest economic sector.**
   - ☐ Industries
   - ☐ Agriculture
   - ☐ Fishing
   - ☐ Hotels & tourism
   - ☐ Mines & minerals
   - ☐ Livestock & dairy
   - ☐ Any other (Specify) _____

Sr. No.	Sector	How is this a strong or weak sector?	Suggestions	Future potential sector (order 1-5)
1				☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
2				☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
3				☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
4				☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
5				☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

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"Preparation of Development Master Plans for
Twelve (12) Major Secondary Cities of Sindh
(Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)"
DIRECTORATE OF URBAN, REGIONAL POLICY & STRATEGIC PLANNING
P & D DEPARTMENT GOVERNMENT OF SINDH

2. How can the city be developed to cater the residents' needs of the city? Rate the existing status of various sectors to assess the situation of city.

Sr. No.	Sectors	Existing status (G-Good, F-Fare, B -Bad)	Future needs for the next 20 years
1.	Housing	☐ Good ☐ Fare ☐ Bad	
2.	Basic Education (Primary – secondary)	☐ Good ☐ Fare ☐ Bad	
3.	Higher Education	☐ Good ☐ Fare ☐ Bad	
4.	Primary health care facilities	☐ Good ☐ Fare ☐ Bad	
5.	Secondary & tertiary Health care	☐ Good ☐ Fare ☐ Bad	
6.	Water	☐ Good ☐ Fare ☐ Bad	
7.	Sanitation	☐ Good ☐ Fare ☐ Bad	
8.	Waste management	☐ Good ☐ Fare ☐ Bad	
9.	Sports & recreation	☐ Good ☐ Fare ☐ Bad	
10.	Public Spaces	☐ Good ☐ Fare ☐ Bad	
11.	Transport infrastructure	☐ Good ☐ Fare ☐ Bad	
12.	Intercity public transport (railway, bus)	☐ Good ☐ Fare ☐ Bad	
13.	Freight transport (rail, road)	☐ Good ☐ Fare ☐ Bad	
14.	Local public transport	☐ Good ☐ Fare ☐ Bad	
15.	Electricity	☐ Good ☐ Fare ☐ Bad	
16.	Natural gas / alternative energy	☐ Good ☐ Fare ☐ Bad	
17.	Any other	☐ Good ☐ Fare ☐ Bad	

Any Suggestions?

_____

_____

_____

_____

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ASIAN CONSULTING ENGINEERS www.asiancon.com

"Preparation of Development Master Plans for
Twelve (12) Major Secondary Cities of Sindh
(Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)"

DIRECTORATE OF URBAN, REGIONAL POLICY & STRATEGIC PLANNING
P & D DEPARTMENT GOVERNMENT OF SINDH

City Name: Babar Mir (Khairpur)

Department: Management and Development foundation (MDF)

Name and Designation: Babar Mir Field Officer

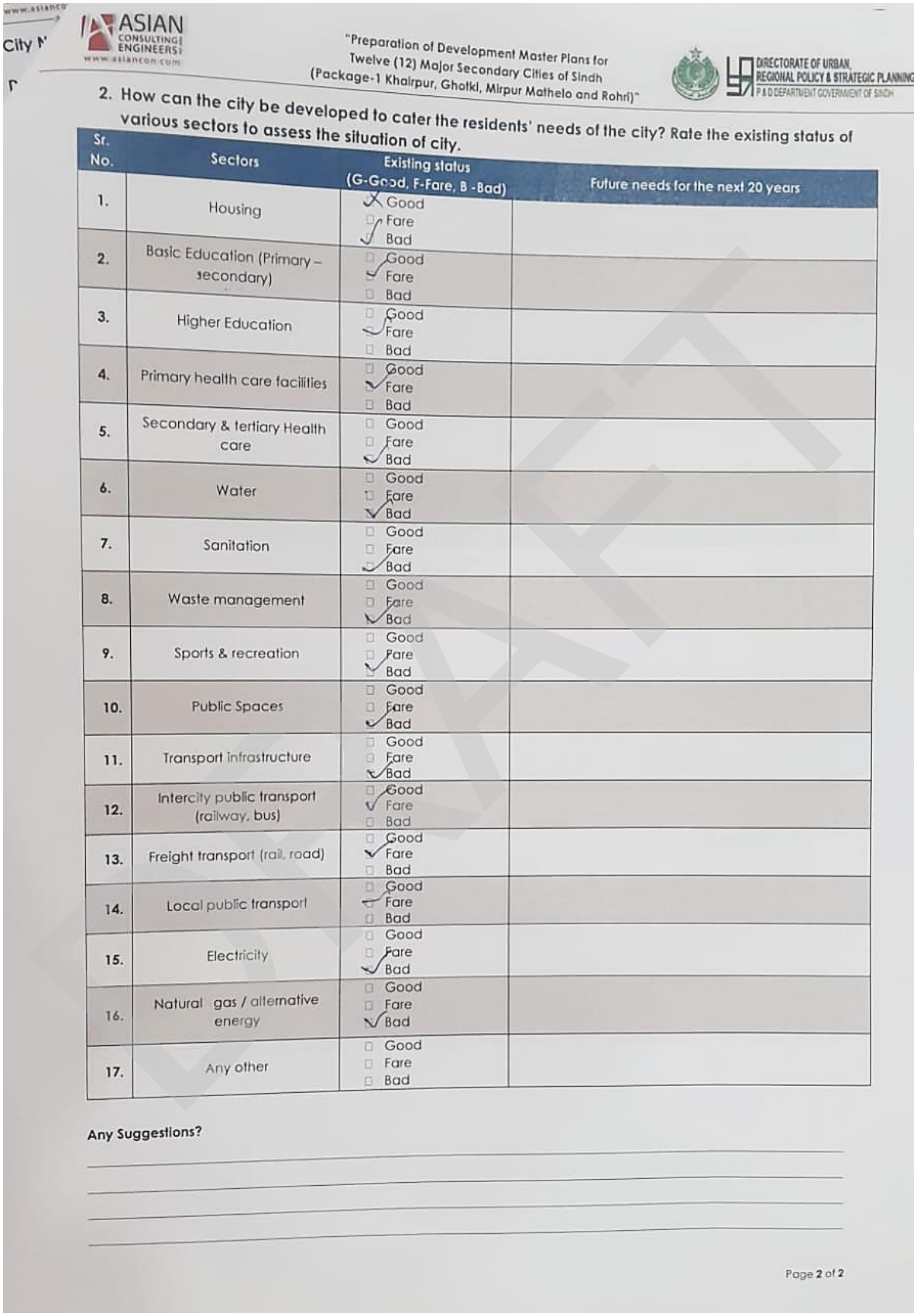
1. What sectors do you think are supporting city's economy? Rate from 1-5, with 1 being the highest, and strongest economic sector.

- ✓ Industries
- ✓ Agriculture
- ☐ Fishing
- ✓ Hotels & tourism
- ☐ Mines & minerals
- ✓ Livestock & dairy
- ☐ Any other (Specify) _____

Sr. No.	Sector	How is this a strong or weak sector?	Suggestions	Future potential sector (order 1-5)
1	Industries	Industries are week.	Improve power supply and Gass	☐ 1 ☑ 2 ☐ 3 ☐ 4 ☐ 5
2	Agriculture	Dates are main agricultul in Khairp	we should presdi des to formers Becaus Dates are died.	☐ 1 ☑ 2 ☐ 3 ☐ 4 ☐ 5
3	Hotels	Weak	~~Bad~~ Government Should work on thes	☐ 1 ☐ 2 ☑ 3 ☐ 4 ☐ 5
4	Live Stock	Weak	Medicine quality not Good. ~~foo~~	☐ 1 ☑ 2 ☐ 3 ☐ 4 ☐ 5
5				☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

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"Preparation of Development Master Plans for Twelve (12) Major Secondary Cities of Sindh (Package-1 Khairpur, Ghotki, Mirpur Mathelo and Rohri)"

DIRECTORATE OF URBAN, REGIONAL POLICY & STRATEGIC PLANNING
P & D DEPARTMENT GOVERNMENT OF SINDH

2. How can the city be developed to cater the residents' needs of the city? Rate the existing status of various sectors to assess the situation of city.

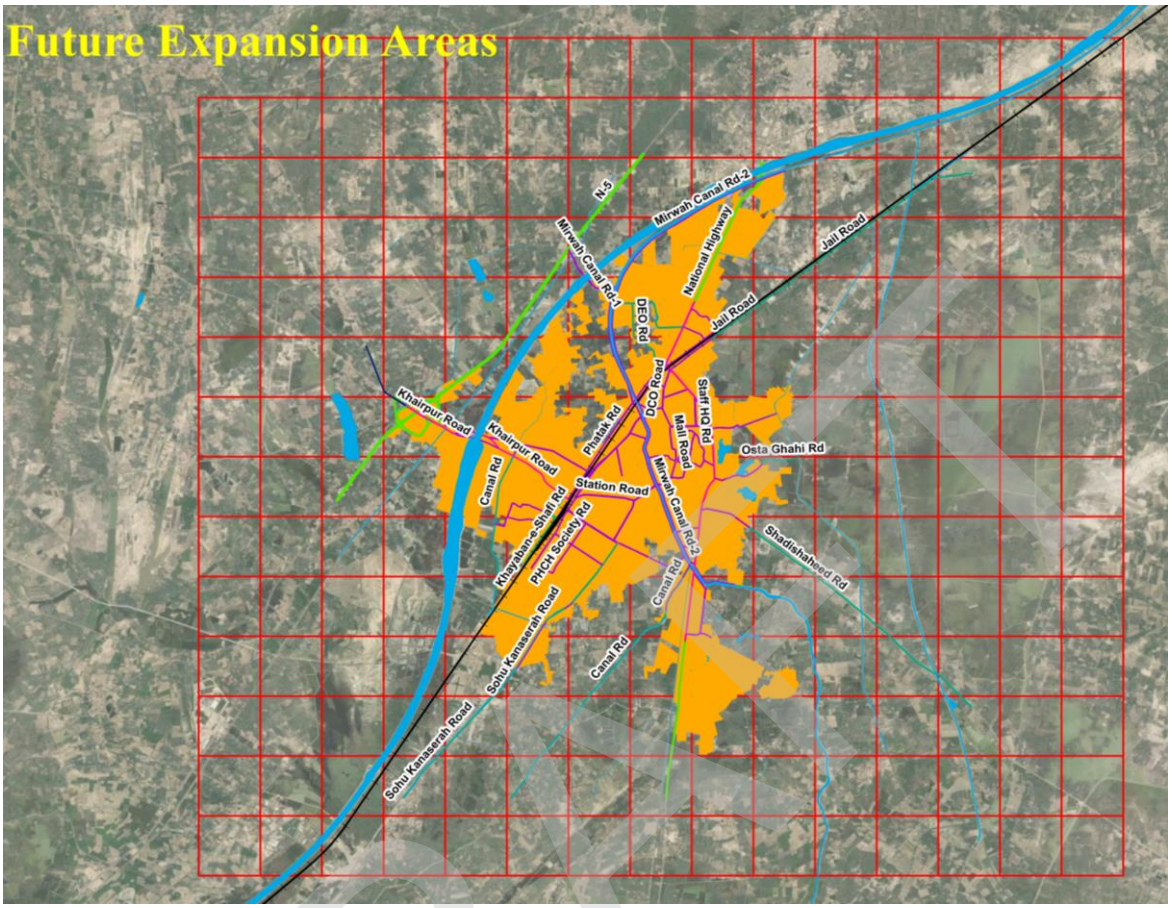
Sr. No.	Sectors	Existing status (G-Good, F-Fare, B -Bad)	Future needs for the next 20 years
1.	Housing	☒ Good ☐ Fare ☑ Bad	
2.	Basic Education (Primary – secondary)	☐ Good ☑ Fare ☐ Bad	
3.	Higher Education	☐ Good ☑ Fare ☐ Bad	
4.	Primary health care facilities	☐ Good ☑ Fare ☐ Bad	
5.	Secondary & tertiary Health care	☐ Good ☐ Fare ☑ Bad	
6.	Water	☐ Good ☐ Fare ☑ Bad	
7.	Sanitation	☐ Good ☐ Fare ☑ Bad	
8.	Waste management	☐ Good ☐ Fare ☑ Bad	
9.	Sports & recreation	☐ Good ☐ Fare ☑ Bad	
10.	Public Spaces	☐ Good ☐ Fare ☑ Bad	
11.	Transport infrastructure	☐ Good ☐ Fare ☑ Bad	
12.	Intercity public transport (railway, bus)	☐ Good ☑ Fare ☐ Bad	
13.	Freight transport (rail, road)	☐ Good ☑ Fare ☐ Bad	
14.	Local public transport	☐ Good ☑ Fare ☐ Bad	
15.	Electricity	☐ Good ☐ Fare ☑ Bad	
16.	Natural gas / alternative energy	☐ Good ☐ Fare ☑ Bad	
17.	Any other	☐ Good ☐ Fare ☐ Bad	

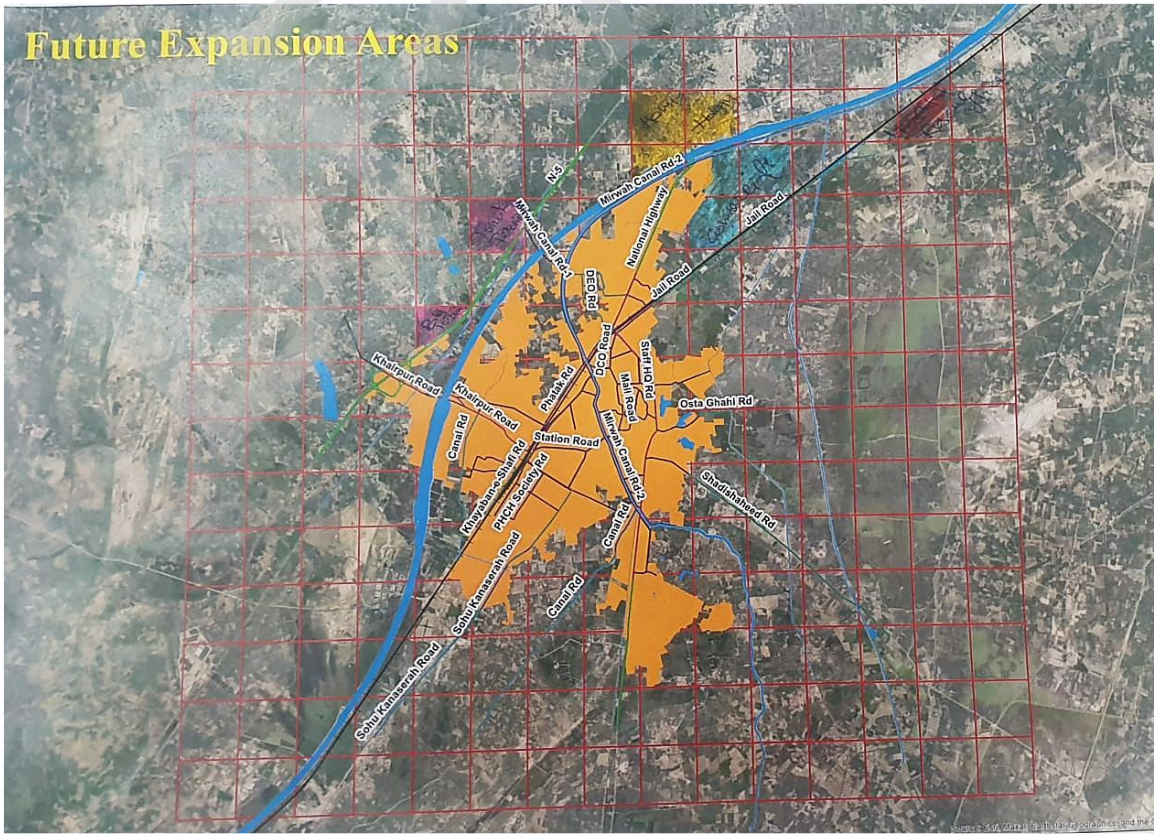
Any Suggestions?

Page 2 of 2

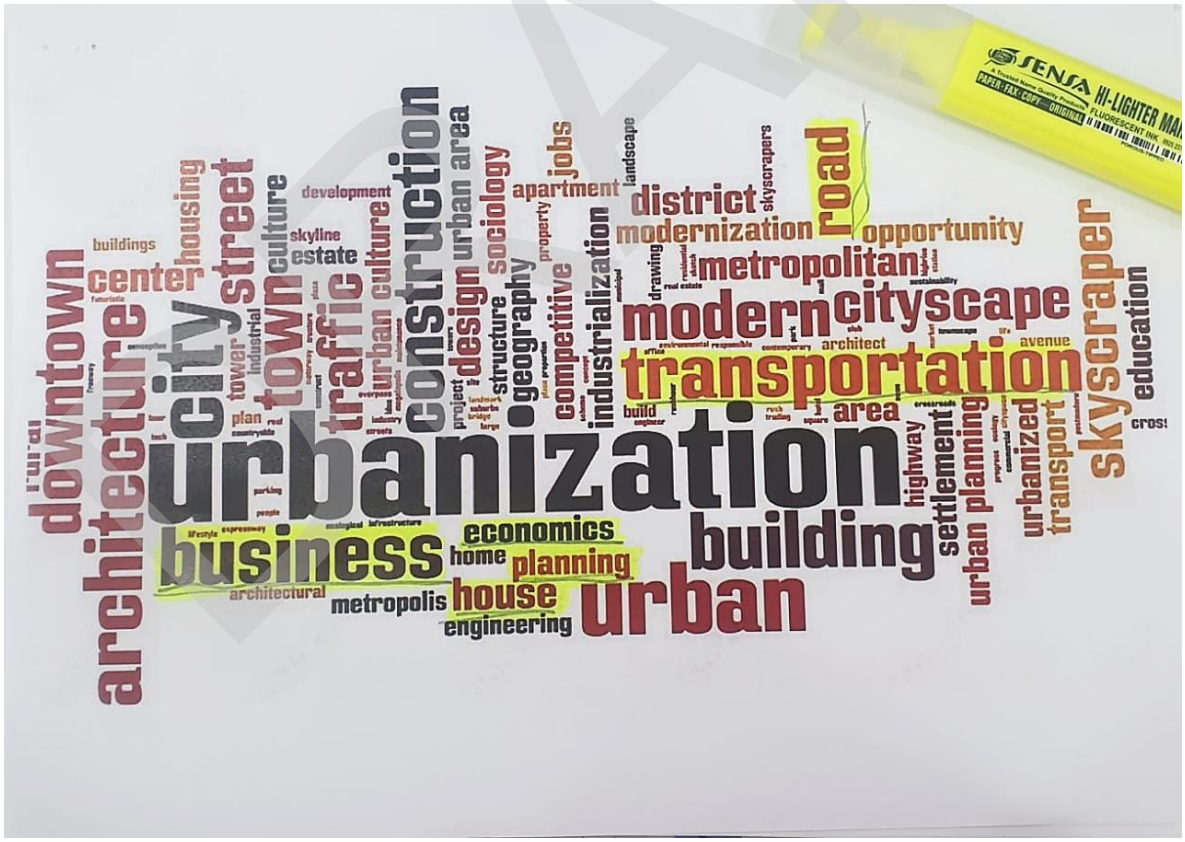
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3. Session 3 - What will be the Future Development?






promote
sustainable
development
management
inclusive
End
resilient
halt
poverty
Ensure
achieve
access
build
combat
hunger
productive
nutrition
healthy
agriculture
opportunities
equality
availability
education
gender
energy
quality
learning
forms
girls
food
use
improved
lifelong
security
infrastructure
Conserve
consumption
desertification
degradation
employment
climate
inequality
sanitation
modern
water
settlements
reliable
work
growth
lives
women
cities
countries
resources
affordable
economic
empower
equitable
oceans
ages
industrialization
innovation
decent
foster
seas
impacts
change
reverse
patterns
marine
Reduce
partnership
implementation
accountable
Protect
Strengthen
Make
land
forests
action
inequality
poverty
unsustainable
human
employment
terrestrial
ecosystems
restore
effective
global
End


urbanization
city
architecture
downtown
business
building
urban
construction
modern
cityscape
transportation
skyscraper
street
town
traffic
center
housing
buildings
culture
skyline
estate
development
apartment
district
modernization
road
opportunity
metropolitan
jobs
urban area
sociology
design
geography
structure
competitive
industrialization
landscape
skyscrapers
drawing
property
architect
avenue
education
area
highway
settlement
urban planning
urbanized
transport
economics
home
planning
house
metropolis
engineering
architectural
tower
plan
industrial
urban culture
SENSA
HI-LIGHTER

C. Vision Workshop Pictures











ANNEXURE - 3: KHAIRPUR BORE LOGS REPORT AND TEST SHEETS

A. Borehole Log Report

14.7 Executive Summary

14.7.1 General

The Client intends to have a Geotechnical Investigation of the proposed area available project **" Preparation of Development Master Plans for Twelve (12) Major Secondary Cities of Sindh (Package-1 Khairpur, Ghotki, Rohri and Mirpur Mathelo)"**

The task was entrusted to **Asian Consulting Engineers Pvt. Ltd**. to carry out the geotechnical investigations of the project. Geotechnical investigations aimed at ascertaining the subsoil information prevailing at the project site i.e., generalized lithology, geotechnical characteristics of each encountered stratum and the corresponding design of foundation system.

A comprehensive scope of geotechnical investigations was defined by the Client. These investigations comprised drilling of boreholes, soil sampling, laboratory testing, evaluation of sub-surface conditions, recommendation of foundation system and preparation of geotechnical investigations report. The field investigations for this project were carried out during the months of **July 2025**. The details on each aspect of these geotechnical investigations are covered in forth coming dedicated chapters of this report.

Based on field investigations, laboratory test results, interpretation and structural requirements, feasibility of several foundation options was evaluated. Considering economy and safety, as well as the structural requirements, foundation options have been recommended to support the structural loadings.

Structural engineer has been provided the choice to select foundations based on structural analysis and design. Alternate foundation options can be evaluated if required by the Structural Designers. The variation of net allowable bearing pressures is presented in this report.

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14.8 Introduction

To evaluate the subsurface conditions at site and to arrive at a safe and economical design of the foundation for the proposed development works, geotechnical investigations were considered necessary. The task of investigations was entrusted to M/s Asian Consulting Engineers (Pvt) Ltd, Lahore by the Client. These investigations were carried out in the month of July 2025. This report provides an account of the subsurface activities carried out at the site, the characteristics of subsurface materials, and details of field and laboratory tests and the necessary recommendations for the design & construction of foundation.

14.8.1 Objectives of Geotechnical Investigation

The geotechnical investigations were undertaken to meet the following objectives:

1. To delineate the major subsoil types spread over the site area.
2. To delineate the location of groundwater and its fluctuations within the project area if encountered.
3. To evolve parameters for the design of foundations of the proposed structure.
4. To evaluate the geotechnical considerations for the construction of foundation.

14.8.2 Scope of Geotechnical Investigation

The following geotechnical investigation plan was developed to fulfil the above-mentioned objectives:

- Execution of Six (06) boreholes at preidentified location up to the maximum depth of 50 feet below E.G.L within the project area by Hand Auger..
- Analyses of field & laboratory data and determination of foundation design parameters including soil parameters, foundation type, foundation depth, foundation size versus net allowable bearing pressure.
- Compilation of a comprehensive Geotechnical Investigations report based on the above studies and submission of the report to the Client.

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14.9 Geology and Seismicity of the Area

14.9.1 Geology of the Area

Khairpur

Khairpur district displays a diverse geological setting, transitioning from fertile alluvial plains near the Indus River to the arid Nara Desert in the east. The plains are covered by thick Quaternary alluvium, consisting of sand, silt, and clay deposited through fluvial processes, while the desert region is dominated by windblown dune sands that can reach significant thicknesses. Beneath these surface deposits lies the Jacobabad – Khairpur structural high, a basement uplift that has influenced sedimentation and hydrocarbon accumulation since the Jurassic. This combination of recent sediments and deeper structural features makes Khairpur geologically important both for agriculture and subsurface resource exploration.

14.9.2 Surficial Geology

The site is situated at an average elevation of 217 meters above mean sea level. The alluvial subsoils are of late Pleistocene and were formed by the flood plains of river Ravi. These consist of clay, silt and sand.

14.9.3 Seismicity of Area

The project area lies in the Lower Indus basin which is seismically moderately active. Probabilistic seismic hazard assessment recently carried out for Lahore area as part of the revision of Seismic Provisions of the Building Code of Pakistan shows that the Project area falls in Zone 2A.

It is, therefore, recommended that the design of the project structures should be based keeping in view the requirements of Zone 2A of Seismic Provisions of the Building Code of Pakistan (2007).

14.10 Field and Lab Geotechnical Investigation

14.10.1 General

Keeping in view the scope of the geotechnical studies, a field investigation program was developed. The investigation included the following activities;

- Drilling of exploratory borehole
- Soil sampling for subsequent laboratory testing

The details of field work conducted at the project site are discussed in this chapter. The locations of exploratory boreholes and test pits are shown on the layout plan attached in Annexure-A.

The field work was supervised by a Geologist (Site Supervisor) who was responsible for client liaison, field co-ordination, logging of the strata encountered and handling of the collected samples. The field work component of the investigation was carried out in the month of July 2025.

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14.10.2 Execution of Boreholes

Boreholes were bored by hand auger drilling having maximum depth of 50 feet below Existing Ground Level (E.G.L) Borehole location plan is attached in Annexure -A of this report.

Field borehole logs were developed based on the materials encountered at the site and were later confirmed based on the laboratory test results. The borehole logs are shown in Annexure-F.

14.10.3 Disturbed Soil Samples

Disturbed soil samples were obtained using a split spoon sampler while performing the SPTs in the boreholes. The specimens collected from boreholes were carefully placed in polythene bags which were stored in plastic jars. All samples were clearly labelled identifying the following details;

- Project name,
- Project ID,
- Borehole designation for which sampling is being performed,
- Sample designation,
- Depth of collection, and
- Date of collection subsequent laboratory for testing.

14.10.4 Ground Water Investigation

Groundwater was not encountered at all depths across the site. Depth of Water tables are mentioned on borehole log for each site. However Seasonal variation might affect the water table.

14.10.5 Discussion of Laboratory Test Results

A. Classification of soil

Bulk Composite representative soil samples were subjected to sieve analysis as per ASTM D 422. Test results indicated that the overburden soils mainly consist of Silty Clay (CL-ML), Silty Sand (SM) and Poorly Graded Sand with Silt (SP-SM) as per unified soil classification system (USCS).

Test Results are attached in Annexure G of the Report.

14.11 Site Geotechnics

14.11.1 General

Geotechnical investigations were planned in such a manner to effectively explore the site geotechnics of the project site.

This Chapter mainly discusses our evaluations for subsoil lithology & stratigraphy, liquefaction potential and other geotechnical characteristics of the soils prevailing at the project site.

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14.11.2 Lithology & Stratigraphy

At the time of these investigations, maximum depth of drilled boreholes was 50 feet below the Existing Ground level (E.G.L.)

General stratigraphy of the project area, as deduced from the site investigations duly corrected in the light of laboratory test results (wherever required), indicates the presence of following stratigraphic units.

14.11.3 Strata Encountered at Different Depths

Table 14-1, Strata Encountered at Different Depths

Stratum	Thickness (ft)	Material Description	Soil Parameters
Stratum - 1	0-15	Silty Clay with variable Sand / Silty Sand	γ_b = 17.0 KN/m^3 c' = 25 kPa Es = 15,000 KN/m^3 μ = 0.35
Stratum - 2	15-25	Sand with varied Silt	γ_b = 18.0 KN/m^3 ϕ' = 32^0 Es = 25,000 KN/m^3 μ = 0.30
Stratum - 3	25-50	Sand with varied Silt	γ_b = 19.0 KN/m^3 ϕ' = 34^0 Es = 45,000 KN/m^3 μ = 0.30
Water Table was encountered at variable depth across all of the sites.			

14.11.4 Shear Strength

Direct Shear Test carried out relatively Coarse Grained Sils indicated that the soils are in medium dense state of Packing.

14.11.5 Expansion Potential

The plasticity index (PI) of the soil provides an indication of how much clay will shrink or swell. The higher the PI, the greater is the shrink-swell potential. The PI of top onsite soils are plastic nature having PI < 15, indicates that the cohesive on-site soils are having low expansion potential.

14.11.6 Liquification Potential

Loose to medium dense, water-submerged, cohesion-less soils are susceptible to liquefaction under dynamic loads caused by earthquakes. Liquefaction results in total or partial loss of shear strength thereby leading to substantial subsidence, ground heave and/or uplifting of lightweight structures, etc

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During these investigations, groundwater was not encountered at an depth of 90 feet. Moreover, the overburden soils consist of thick cover of cohesive soil stratum at top. Therefore, as such the soil deposits are not likely to liquefy during earthquakes.

14.11.7 Chemical Aggressively

A study of salt concentration determined at a few spread-out locations indicates that sulphates and chlorides are present in low proportions in all the tested soil samples as per ACI Building Code Requirements. Therefore, OPC can be used in foundation concrete.

14.11.8 Site Class

Based on the properties of the on-site soils, the site is classified as Site Class D in accordance with ASCE 7 as recommended in Pakistan Building Code 2021.

14.12 Foundation Design

14.12.1 General

Based on the field investigations and the subsequent laboratory testing, subsurface strata at the project site have been established and the corresponding design of foundations has been carried out. The details of foundation design recommendations are provided in the following sections.

14.12.2 Geotechnical Design Criteria

The foundations of the proposed structures should meet the following minimum design criteria:

- These should be safe against shear failure of the supporting ground.
- These should not settle excessively under the service loads. A limit 50 mm has been put on the total settlement Raft foundation respectively. On the field investigations and the subsequent laboratory testing, subsurface strata at the project site have been established and the corresponding design of foundations has been carried out. The details of foundation are provided in the following sections.
- The angular distortion between two adjacent foundations of the same building block should not exceed 1/500.
- Preferably, the building blocks of different heights located adjacent to each other, should be structurally isolated, so as to ensure better performance.
- The foundations must stay safe under tensile, lateral, moment and earthquake loadings.

14.12.3 Foundation Type & Depth

The field investigation data indicated that the overburden soil generally has medium strength. Based on the loading requirements of the proposed structure and the existing subsurface conditions.

For light weight or temporary structures strip Square Foundations can be opted at 2.5 feet from EGL.

14.12.4 Foundation Recommendation

The footings to be placed at **desired depth** should be placed below the existing ground level on a subgrade to be prepared as described below:

1. Excavate soil at the foot prints to desired depth below the existing ground level (EGL).
2. The excavation should extend at least 4-inch away from the footing edges.
3. Trim any moist or organic soil layer and Proof roll foundation sub-grade using appropriate compaction equipment. Compact the bed, of foundation at 95 % of MDD.
4. Backfill the foundation pit/trench with one (01) foot, A-3 type soil (as per AASHTO classification) with fines content less than 15%, placed in layers not exceeding six (06") inches in thickness and compacted to dry density not less than 95% Modified Proctor dry density.
5. Provide a well-compacted pad of at least 4 inches of 1:4:8 P.C.C. and the footing should bear on this pad.

If the material encountered at the base of the foundation conforms to A-3 type soil with **fines content less than 15%**, and with a coefficient of uniformity **(Cu ≥ 4)** greater than or equal to 4 and a coefficient of curvature **(1≤ Cc ≤ 3)** between 1 and 3, then same should be compacted to 95% of the maximum dry density (MDD).

14.12.5 Modulus of Subgrade Reaction (KS)

Vertical Modulus of Subgrade Reaction (Ks) also referred as soil "spring" constant or coefficient of subgrade reaction is defined as the deformation induced in the soil per unit application of pressure. This modulus is frequently used for design of mat foundations and rigid pavements. Its magnitude is not only a function of stiffness of the foundation supporting strata, but it is also depended on the foundation size and its rigidity. The Modulus of Subgrade Reaction can be estimated using the following relationship

(Ref.: Foundation Analysis and Design by J.E. Bowles).

$$Ks = 20\ (FOS)qa \quad (for\ 50\ mm\ settlement)$$

$$ks = 40\ (fOS)qa\ (for\ 25\ mmn\ settlemnt)$$

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14.12.6 Coefficients of Earth Pressures

The on-site soils where silty clay or sandy silts are presents as per the samples obtained from the boreholes are not suitable to be used as backfill behind retaining walls. It should contain limited fines.

The backfill should be compacted to around 90% Modified Proctor maximum dry density. In case of backfill materials, it is considered that as recommended in subsequent section, the materials shall be granular and compacted to a dry density of not less than 95% of the maximum Modified Proctor Density (ASTM D 1557).

The granular backfill materials compacted to these recommended densities must develop an angle of friction of the order of 30 degrees. Therefore, the coefficients of Earth Pressures for the well compacted engineering fill will be as under:

1. Active Earth Pressure (Ka) = 0.33
2. Passive Earth Pressure (K_p) = 3.00
3. At rest Earth Pressure (Ko) = 0.50

14.12.7 Type of Cement

The chemical tests carried out on the soil samples indicate low concentrations of sulphate in the subsoil at the site. Therefore, Ordinary Portland Cement (OPC) should be used in the construction below NSL.

14.12.8 Damp Proofing Measures

Proper damp proofing measures should be taken to prevent the ingress of water in foundations. Besides, adequate provision should be kept preventing the excavation slopes against rains by tarpaulins. Emergency arrangements of dewatering pumps of pumping the rainwater from excavations should also be provided. The Contractor should submit his method statement for the approval of Engineer.

14.13 Earth Work

14.13.1 Clearing, Grubbing, Leveling and Grading

Prior to any construction activity at the site, it must be cleared of all debris, and surface vegetation. This can be carried out by graders/dozers. For levelling and grading, stakes should be installed on a grid marked by Surveying Crews. The required levels to be attained through cut or fill at the grid points must also be identified. The levelling and grading can be carried out by normal earth moving machine.

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14.13.2 Excavations

The excavations for construction of foundations, other substructures or for trenches for utility lines can be made by using conventional earth moving machinery including scrappers, dozers and trenchers etc.

All the excavations should be properly sloped or supported to avoid any stability failure as well as movement in the adjacent structures. After reaching the designed foundation level and before placing the foundation, it is recommended that the soil should be well compacted by using appropriate roller or equivalent.

14.13.3 Fill Materials

A. General Fill

The top soils on site are not suitable as per samples obtained from boreholes. The general backfill should be granular and should contain limited fines <15%.

B. Structural Fill

The fill intended to support the structural foundations or floors must comprise only the "select materials". The "select fill material" must be free of organic and other deleterious substances.

The select fill must be well-graded granular material. The fines (i.e., particles passing no. 200 sieve) fines should not be more than 15%.

C. Backfill for Utility Trenches and around Substructures

The soils used for backfilling the trenches and around substructures must be free draining when im-permeability is not required, when free drainage is desired, or when particularly good bedding or foundations of low compressibility. are desired. Tractor compacted fill or fills compacted by consolidating processes, the materials used must be free draining sandy and gravelly soils.

D. Placement and compaction

Permanent slopes beyond width should not be steeper than 1 vert: 2 Horz. All fill materials must be placed in layers not exceeding 20 cm in loose state- In case of general fill each layer should be compacted to a dry density not less than 90% as determined by Modified Proctor Compaction Tests (ASTM D-1586), or to a minimum relative density of 70 percent. In case of structural fill, the compacted density must not be less than 95% determined based on Modified Proctor Compaction Tests (ASTM D-1586), or not less than 75% of the relative density. All compaction should be carried out at a moisture content, within a tolerable range of -2 to + 2 percent of optimum moisture content.

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14.13.4 Inspections and Construction Verifications

The comments and design recommendations presented in this report are based on descriptions of conditions at known points (i.e., boreholes). Since the subsurface conditions can vary from the inferred ground model for the site, it is important that the ground behaviour should be reviewed during construction and compared with the design assumptions.

The comments and design recommendations presented in this report are based on descriptions of conditions at known points (i.e., boreholes). Prior to construction, confirmatory boreholes should be carried out at the foundation locations to confirm the lithology at critical loading points of the structures.

Accordingly, it is recommended, provision be made for a construction review and performance monitoring program, with inspections to cover but not limited to the following aspects of the works:

- footing excavations
- subgrade preparation at foundation level

14.14 Conclusions and Recommendations

- The geotechnical investigations conducted in the project area indicate that the overburden soils primarily consist of Silty Clay (CL-ML) and Sand with variable Silt (SP-SM).
- The groundwater table was encountered at a varied depth of from the Existing Ground level (EGL).
- Trench excavations having a depth of 5-feet or more must be excavated and shored in accordance with OSHA regulations, and we recommend that the project Contractor be solely responsible for shoring and site safety.
- Water must not infiltrate from any source; proper water proofing must be done in order to avoid any damages to foundation.
- Experienced engineer should observe the construction activities to check that the works are performed in accordance with the plans and specifications. Field and laboratory tests should be performed to confirm that the material quality, compaction and strength meet the project specifications
- If weak/soft soil encountered at foundation excavation base of shallow foundation, it should be completely removed and backfilled with engineered fill material. The guidelines for backfill material is discussed in section 7.3 of this report.
- If there is a substantial lapse of time between submission of this report and the start of work at the site and conditions have changed due either to natural causes or to construction operation at or adjacent

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to site, we urge that we be promptly informed and retained to review our report to determine the applicability of the conclusions and recommendations, considering the changed conditions and/or time lapse.

Engr. Muhammad Hammad Gohar
Senior Geotechnical Engineer
PEC: CIVIL/52452
Engineers Australia - ANZSCO: 233211
Asian Consulting Engineers Pvt. Ltd.

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14.15 Limitations

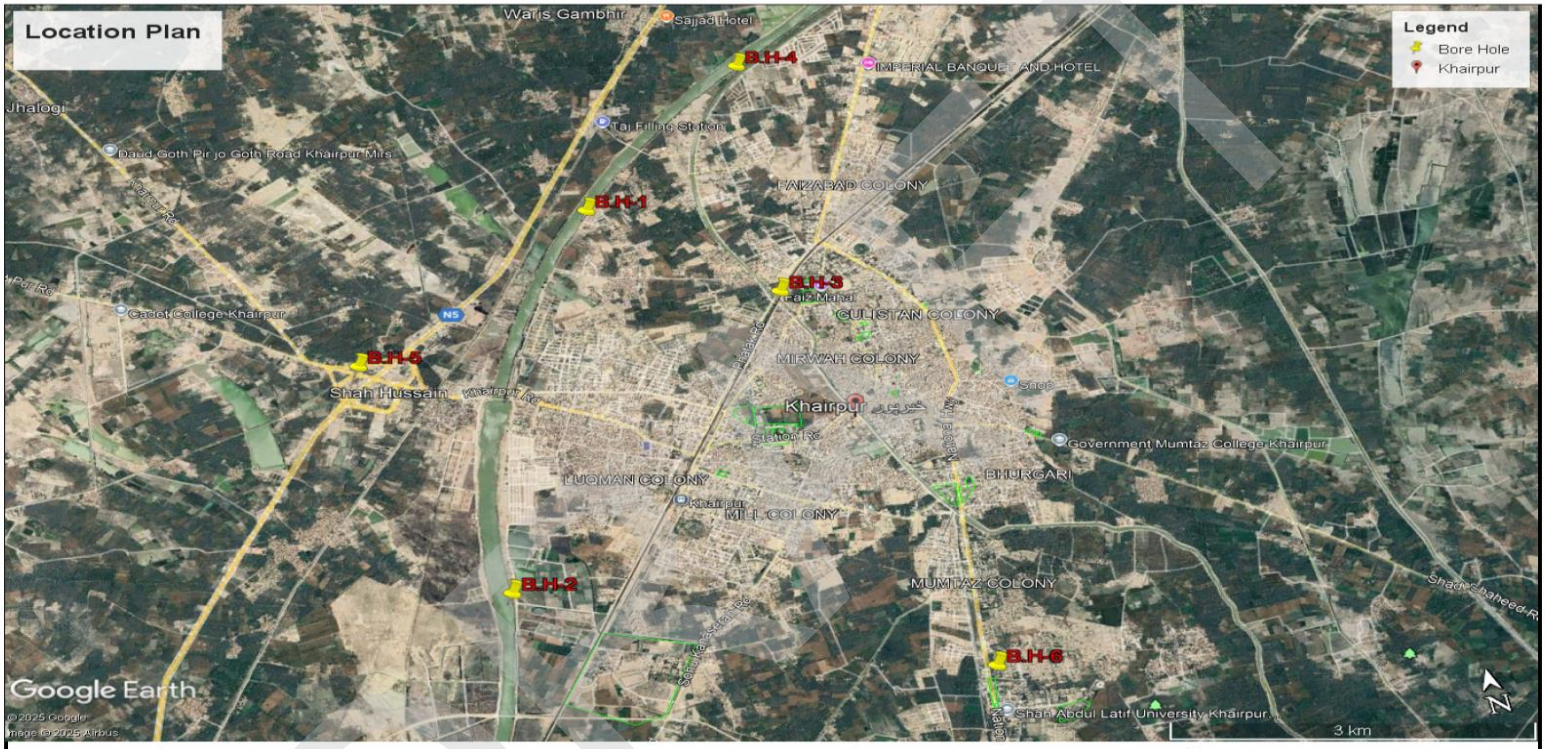
This report has been prepared by **"Asian Consulting Engineers Pvt. Ltd. Lahore** subjects to the following limitations:

- This report deals with geotechnical issues only.
- The comments given in this report are intended only for the guidance of design engineers. This report is intended solely for the Client named.
- No portion of this report may be used as a separate entity, it is written to be read in its entirety.
- Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations and conditions which were not detected or could be anticipated at the time of the site investigation may exist.
- The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.
- This work has been undertaken in accordance with normally accepted geotechnical engineering practices and for site assessments.
- Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **Asian Consulting Engineers Pvt. Ltd. Lahore** accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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A. Location Plan



Date	Coordinate			Drawing Title	Project	Consultant
	Bore Hole No	Northing	Easting			
22-Jul-25	1	27.5497	68.7368	Bore Hole Location Plan	Khair Pur	ASIAN GEOMATS www.asiangeomats.com
	2	27.5113	68.7213			
	3	27.5378	68.7512			
	4	27.5629	68.7536			
	5	27.5370	68.7137			
	6	27.4963	68.7592			

B. Bore Logs and Test Sheets

ASIAN GEOMATS

Project :	Rohri Canal Road Khairpur.		
Water Table	9'	**Date:**	22/07/2025
Northing	27.5497	**Easting**	68.73680
Bore Hole No	**1**		

Type of sample	Depth (feet)	Sample	Depth (feet)	Strata Encountered
1	5	◊	0-20	Dark Brown Silty Clay
2	10	◊ ṯ		
3	15	◊		
4	20	◊		
5	25	◊	20-35	Light Grey Silty Sand
6	30	◊		
7	35	◊		
8	40	◊	35-50	Poorly Graded Sand with Silt
9	45	◊		
10	50	◊		

Legend

Disturbed Sample	◊		**Fill**
Undisturbed Sample	Λ		**Poorly graded sand**
S.P.T	↓		**Sandy Silt**
Water Table	ṯ		**Silty Clay**
Drill Core Sample	Z̤		**Lean Clay**
Vane Shear Test	⊗		**Silty Sand**
			Clayey Silt

Tested By: Checked By:

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ASIAN GEOMATS

www.asiangeomats.com

Project :	Rohri Canal Bank Road Khairpur.		
Water Table	4'	**Date:**	23/07/2025
Northing	27.5113	**Easting**	68.72130
Bore Hole No	**2**		

Type of sample	Depth (feet)	Sample	Depth (feet)	Strata Encountered
1	5	◊ ṭ	0-50	Poorly Graded Sand with Silt
2	10	◊		
3	15	◊		
4	20	◊		
5	25	◊		
6	30	◊		
7	35	◊		
8	40	◊		
9	45	◊		
10	50	◊		

Legend

Disturbed Sample	◊	**Fill**
Undisturbed Sample	Δ	**Poorly graded sand**
S.P.T	↓	**Sandy Silt**
Water Table	ṭ	**Silty Clay**
Drill Core Sample	Ẓ	**Lean Clay**
Vane Shear Test	⊗	**Silty Sand**
		Clayey Silt

Tested By: Checked By:

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ASIAN GEOMATS

www.asiangeomats.com

Project :	Near Railway Phatak Khairpur.		
Water Table	14'	**Date:**	23/07/2025
Northing	27.5378	**Easting**	68.75120
Bore Hole No	3		

Type of sample	Depth (feet)	Sample	Depth (feet)	Strata Encountered
1	5	◊	0-5	Dark Brown Silty Clay
2	10	◊	5-10	Light Grey Silty Sand
3	15	◊ ṭ	10-50	Poorly Graded Sand with Silt
4	20	◊		
5	25	◊		
6	30	◊		
7	35	◊		
8	40	◊		
9	45	◊		
10	50	◊		

Legend		
Disturbed Sample	◊	Fill
Undisturbed Sample	Δ	Poorly graded sand
S.P.T	↓	Sandy Silt
Water Table	ṭ	Silty Clay
Drill Core Sample	Ẓ	Lean Clay
Vane Shear Test	⊗	Silty Sand
		Clayey Silt

Tested By: Checked By:

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ASIAN GEOMATS

www.asiangeomats.com

Project :	Mirwah Canal Road Khairpur.		
Water Table	7'	**Date:**	22/07/2025
Northing	27.5629	**Easting**	68.75360
Bore Hole No	**4**		

Type of sample	Depth (feet)	Sample	Depth (feet)	Strata Encountered
1	5	◊	0-5	Dark Brown Silty Clay
2	10	◊ ţ	5-10	Brown Sandy Silt
3	15	◊	10-50	Light Grey Silty Sand
4	20	◊		
5	25	◊		
6	30	◊		
7	35	◊		
8	40	◊		
9	45	◊		
10	50	◊		

Legend

Disturbed Sample	◊	Fill
Undisturbed Sample	Λ	Poorly graded sand
S.P.T	↓	Sandy Silt
Water Table	ţ	Silty Clay
Drill Core Sample	Ẓ	Lean Clay
Vane Shear Test	⊗	Silty Sand
		Clayey Silt

Tested By: Checked By:

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ASIAN GEOMATS

www.asiangeomats.com

Project :	Near Underpass Khairpur.		
Water Table	4'	**Date:**	22/07/2025
Northing	27.537	**Easting**	68.71370
Bore Hole No	**5**		

Type of sample	Depth (feet)	Sample	Depth (feet)	Strata Encountered
1	5	◊ ṯ	0-10	Dark Brown Silty Clay
2	10	◊		
3	15	◊	10-50	Light Grey Silty Sand
4	20	◊		
5	25	◊		
6	30	◊		
7	35	◊		
8	40	◊		
9	45	◊		
10	50	◊		

Legend		
Disturbed Sample	◊	Fill
Undisturbed Sample	Δ	Poorly graded sand
S.P.T	↓	Sandy Silt
Water Table	ṯ	Silty Clay
Drill Core Sample	Ẓ	Lean Clay
Vane Shear Test	⊗	Silty Sand
		Clayey Silt

Tested By: Checked By:

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ASIAN GEOMATS

Project :	Front Wapda Office Khairpur.		
Water Table	7'	**Date:**	23/07/2025
Northing	27.4963	**Easting**	68.75920
Bore Hole No	**6**		

Type of sample	Depth (feet)	Sample	Depth (feet)	Strata Encountered
1	5	◊	0-5	Dark Brown Silty Clay
2	10	◊ ṯ	5-50	Light Grey Silty Sand
3	15	◊		
4	20	◊		
5	25	◊		
6	30	◊		
7	35	◊		
8	40	◊		
9	45	◊		
10	50	◊		

Legend

Disturbed Sample	◊	**Fill**
Undisturbed Sample	Δ	**Poorly graded sand**
S.P.T	↓	**Sandy Silt**
Water Table	ṯ	**Silty Clay**
Drill Core Sample	Z̤	**Lean Clay**
Vane Shear Test	⊗	**Silty Sand**
		Clayey Silt

Tested By: Checked By:

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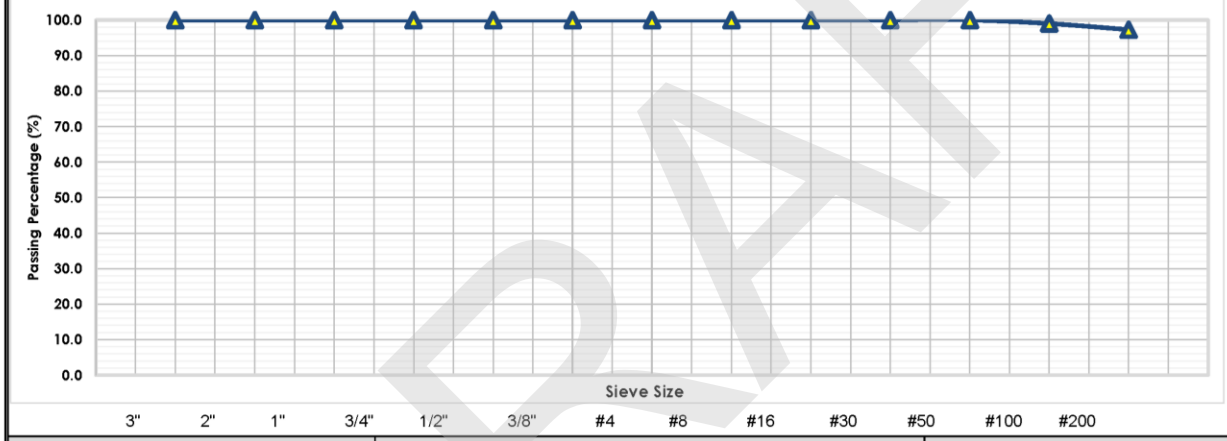
C. Soil Classification

ASIAN GEOMATS

www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	1	**Sample No :**	1
Depth (ft) :	5.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	99.0
0.075	97.3

Gravel %	Sand %	Silt & Clay %
0	3	97

Tested By :

Checked By:

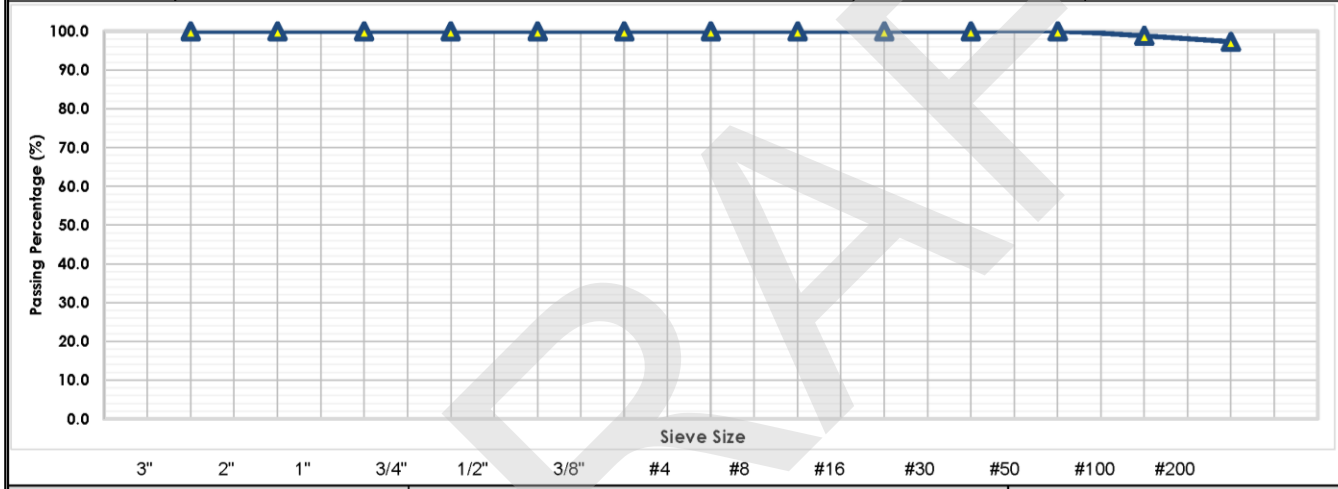
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ASIAN GEOMATS

www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	1	**Sample No :**	2
Depth (ft) :	10.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	98.8
0.075	97.3

Gravel %	Sand %	Silt & Clay %
0	3	97

Tested By :

Checked By:

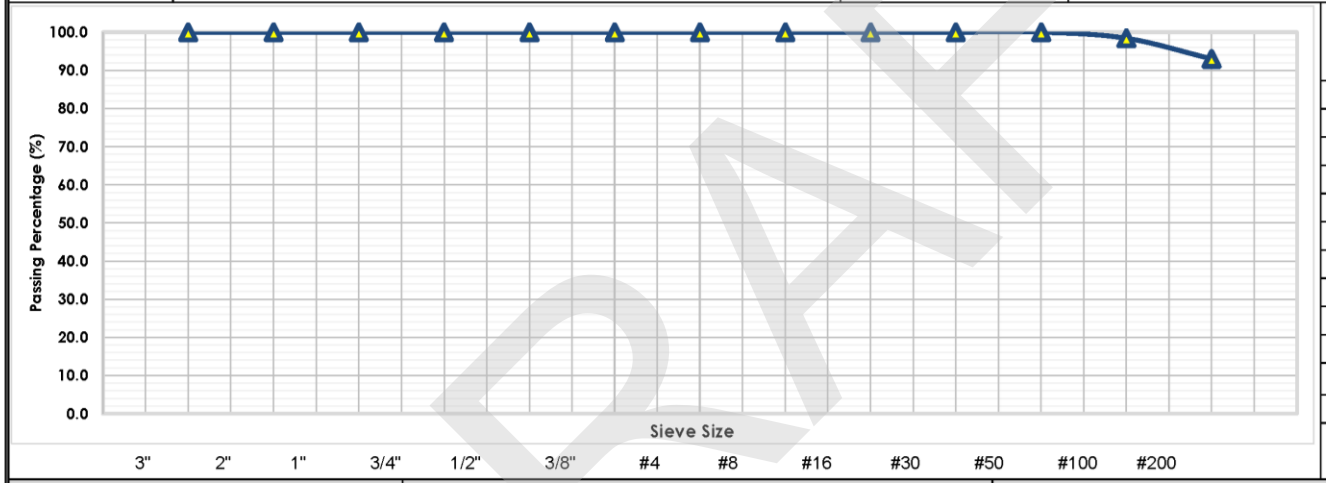
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	1	**Sample No :**	3
Depth (ft) :	15.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	98.4
0.075	93.0

Gravel %	Sand %	Silt & Clay %
0	7	93

Tested By :

Checked By:

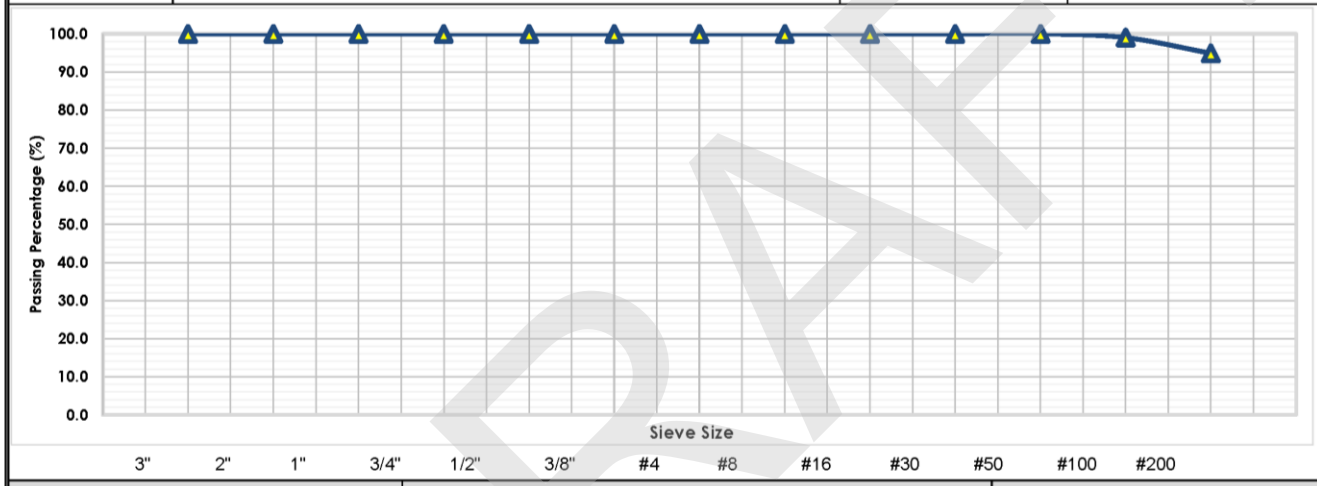
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	1	**Sample No :**	4
Depth (ft) :	20.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	99.0
0.075	94.9

Gravel %	Sand %	Silt & Clay %
0	5	95

Tested By :

Checked By:

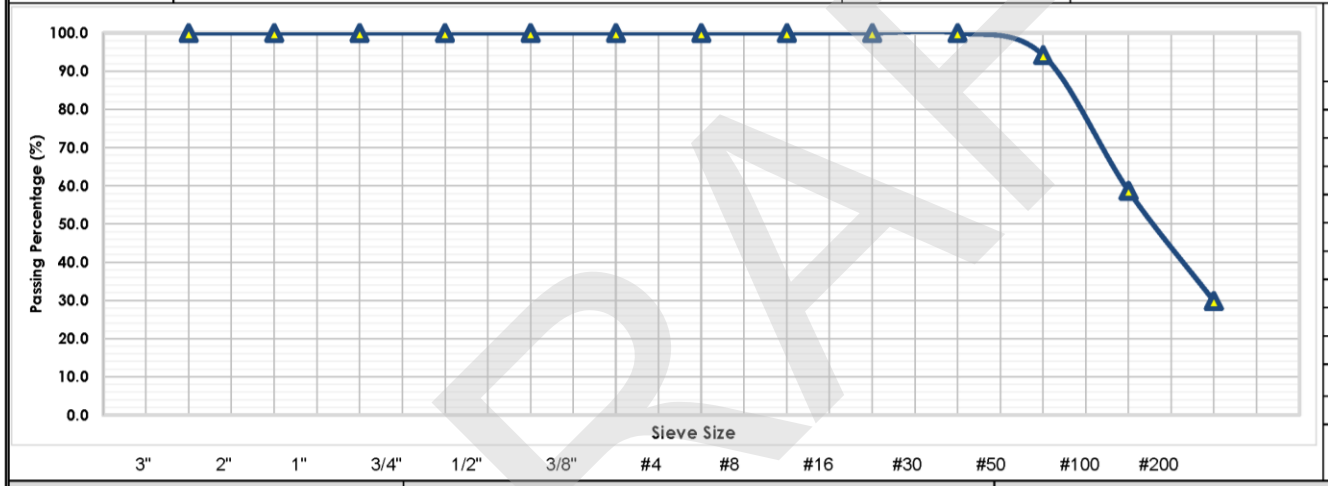
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www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	1	**Sample No :**	6
Depth (ft) :	30.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	94.2
0.15	58.7
0.075	29.8

Gravel %	Sand %	Silt & Clay %
0	70	30

Tested By :

Checked By:

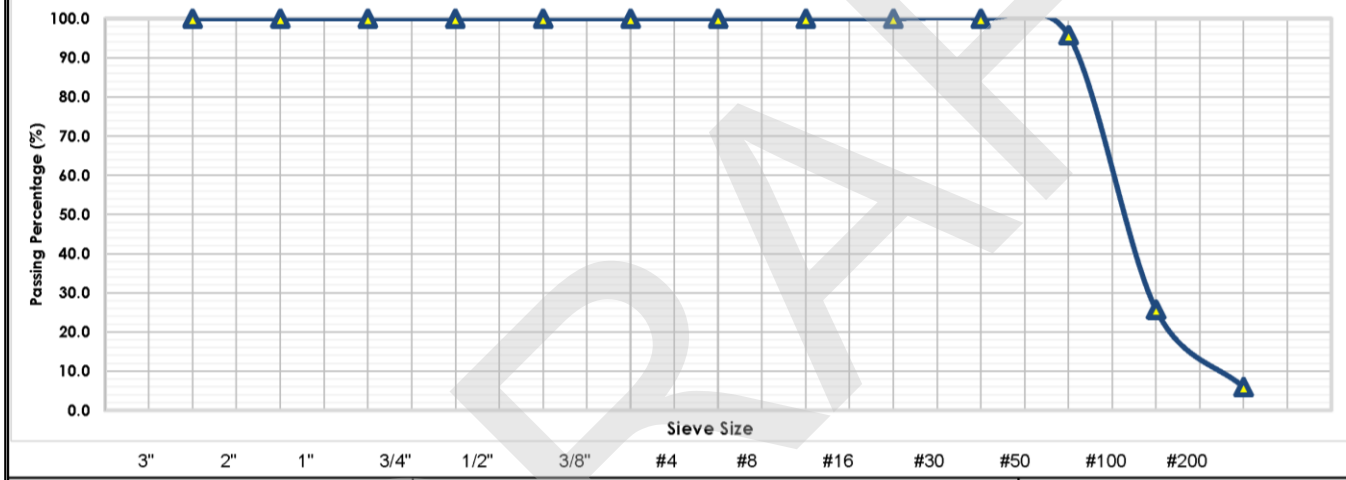
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	1	**Sample No :**	8
Depth (ft) :	40.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.8
0.15	25.7
0.075	5.9

Gravel %	Sand %	Silt & Clay %
0	94	6

Tested By :

Checked By:

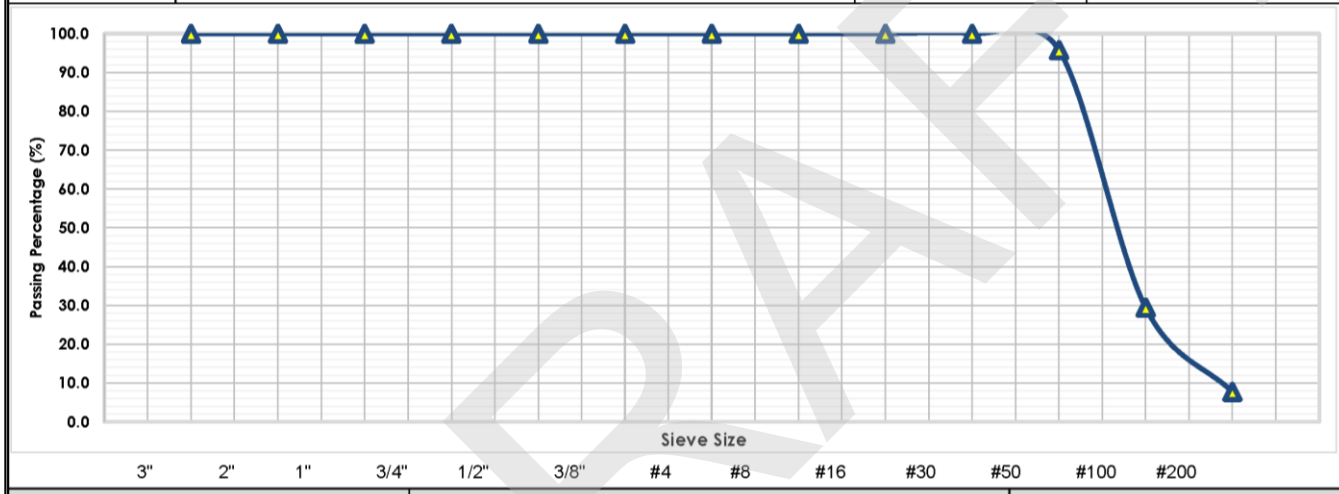
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	1	**Sample No :**	10
Depth (ft) :	50.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.8
0.15	29.4
0.075	7.7

Gravel %	Sand %	Silt & Clay %
0	92	8

Tested By :

Checked By:

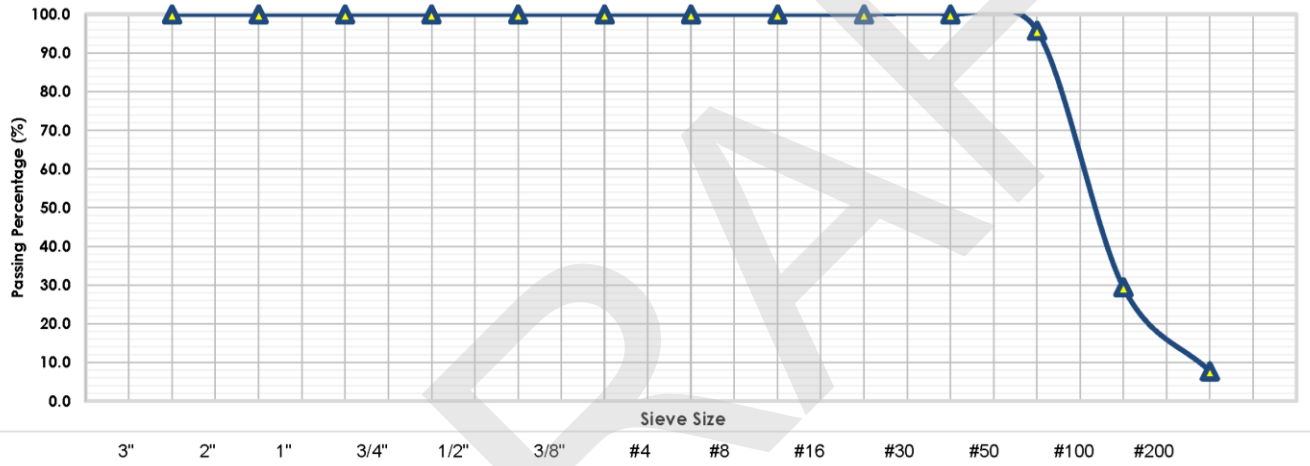
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	2	**Sample No :**	1
Depth (ft) :	5.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.8
0.15	29.4
0.075	7.7

Gravel %	Sand %	Silt & Clay %
0	92	8

Tested By :

Checked By:

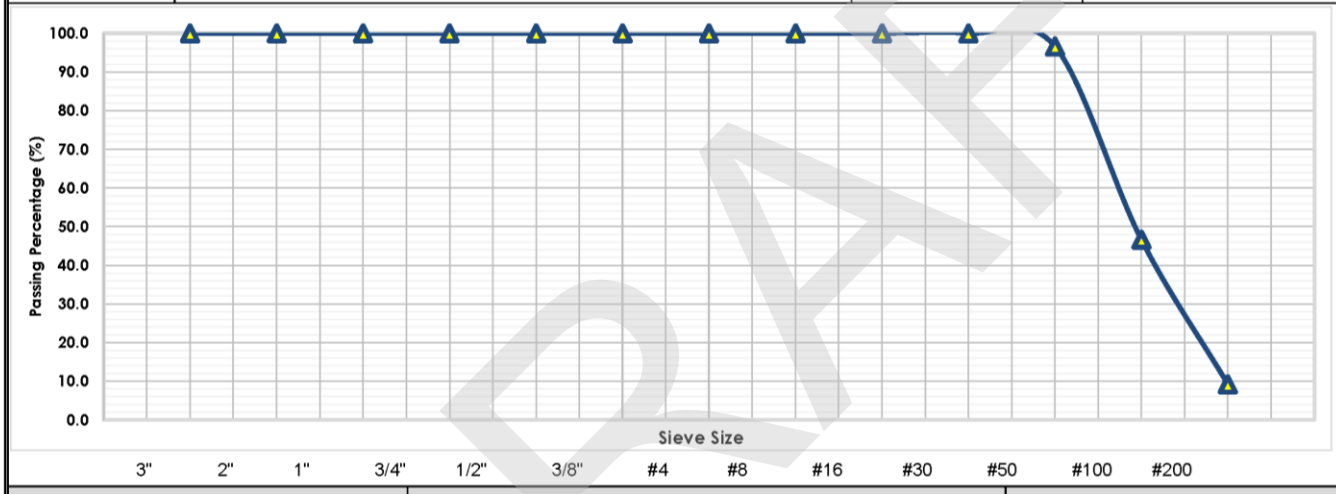
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	2	**Sample No :**	2
Depth (ft) :	10.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	96.6
0.15	46.6
0.075	9.2

Gravel %	Sand %	Silt & Clay %
0	91	9

Tested By :

Checked By:

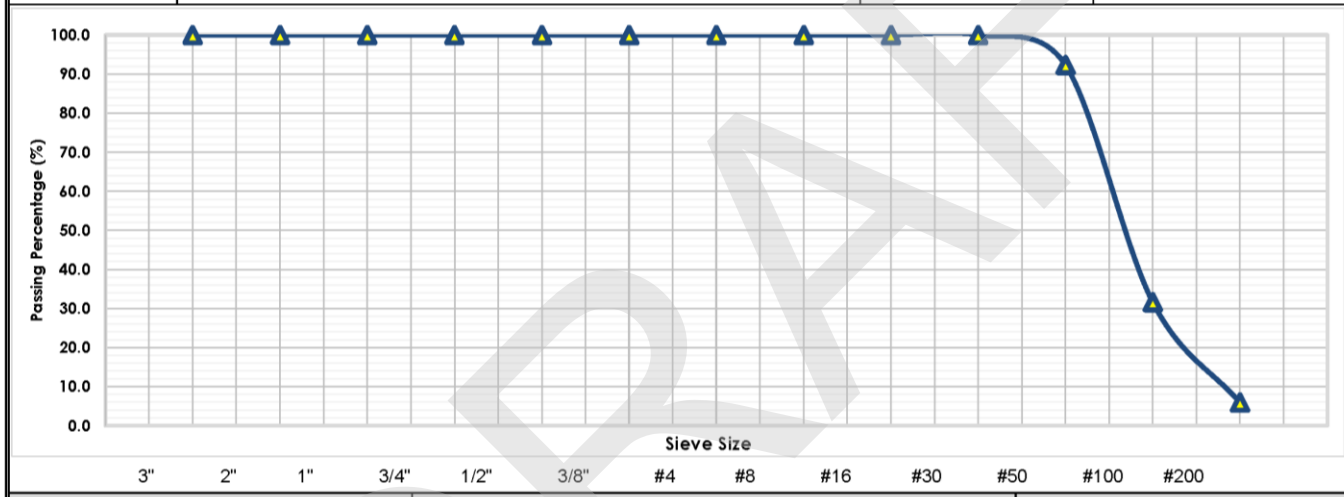
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	2	**Sample No :**	4
Depth (ft) :	20.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	92.3
0.15	31.6
0.075	5.9

Gravel %	Sand %	Silt & Clay %
0	94	6

Tested By :

Checked By:

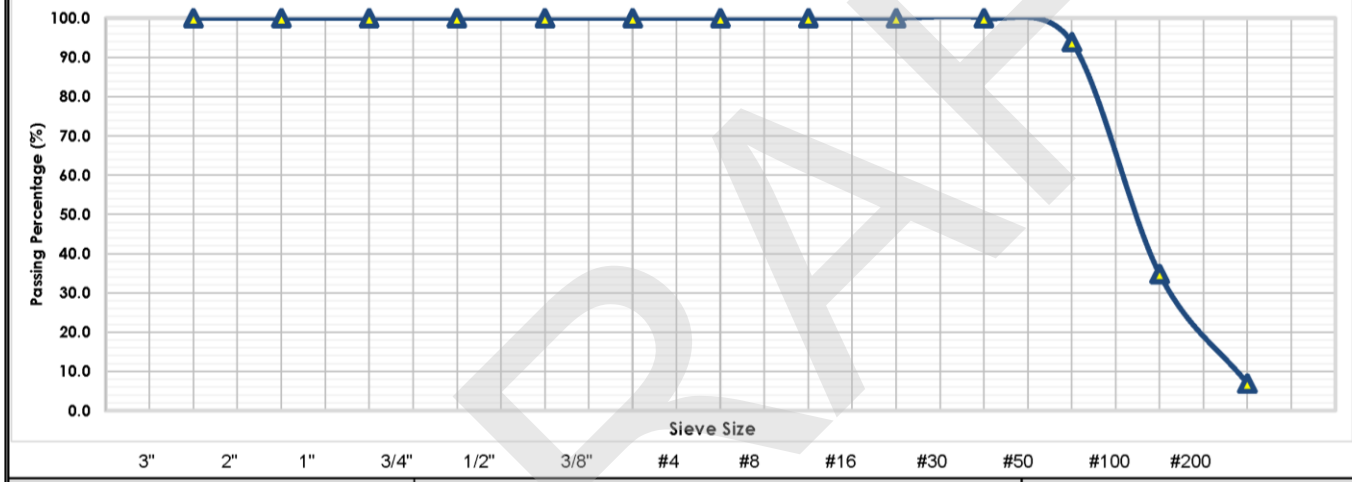
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	2	**Sample No :**	6
Depth (ft) :	30.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	93.9
0.15	34.8
0.075	6.9

Gravel %	Sand %	Silt & Clay %
0	93	7

Tested By :

Checked By:

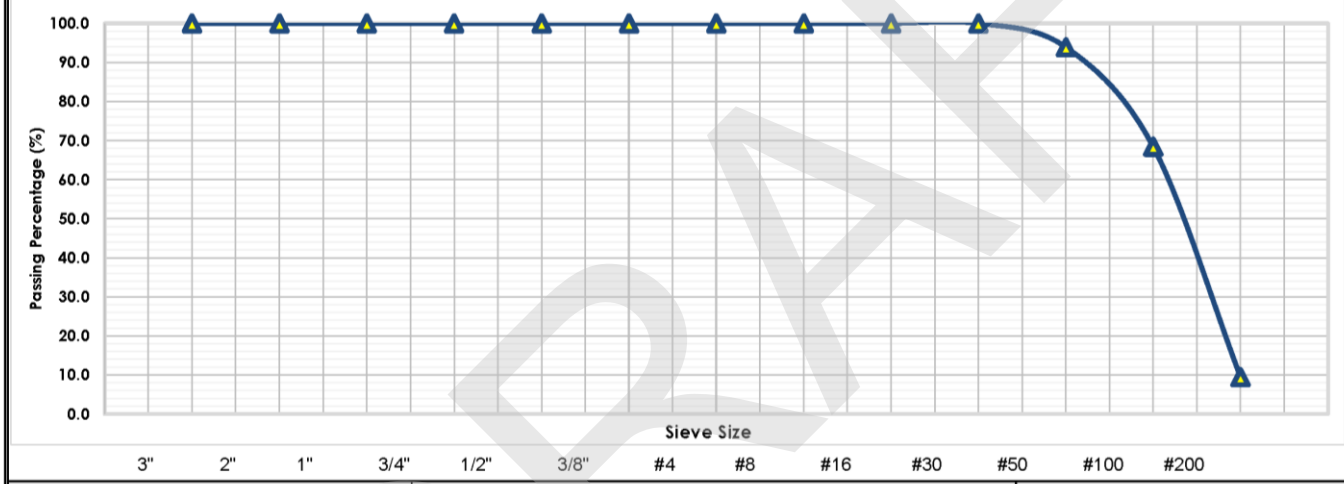
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	2	**Sample No :**	8
Depth (ft) :	40.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	93.9
0.15	68.4
0.075	9.4

Gravel %	Sand %	Silt & Clay %
0	91	9

Tested By :

Checked By:

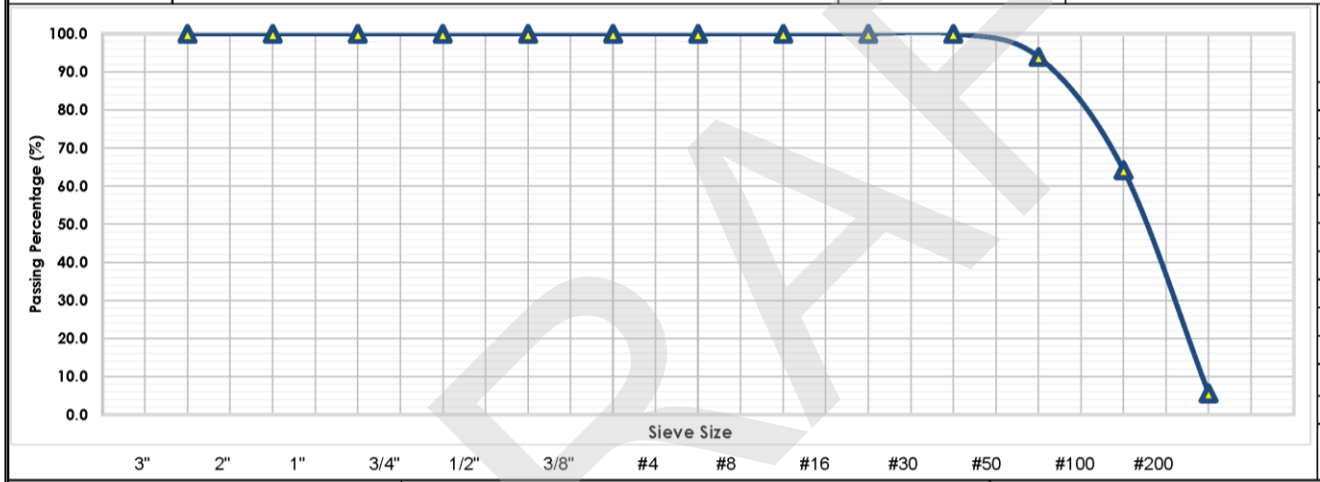
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ASIAN GEOMATS

www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Rohri Canal Road Khairpur.		
Borehole No:	2	**Sample No :**	10
Depth (ft) :	50.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	93.9
0.15	64.2
0.075	5.6

Gravel %	Sand %	Silt & Clay %
0	94	6

Tested By :

Checked By:

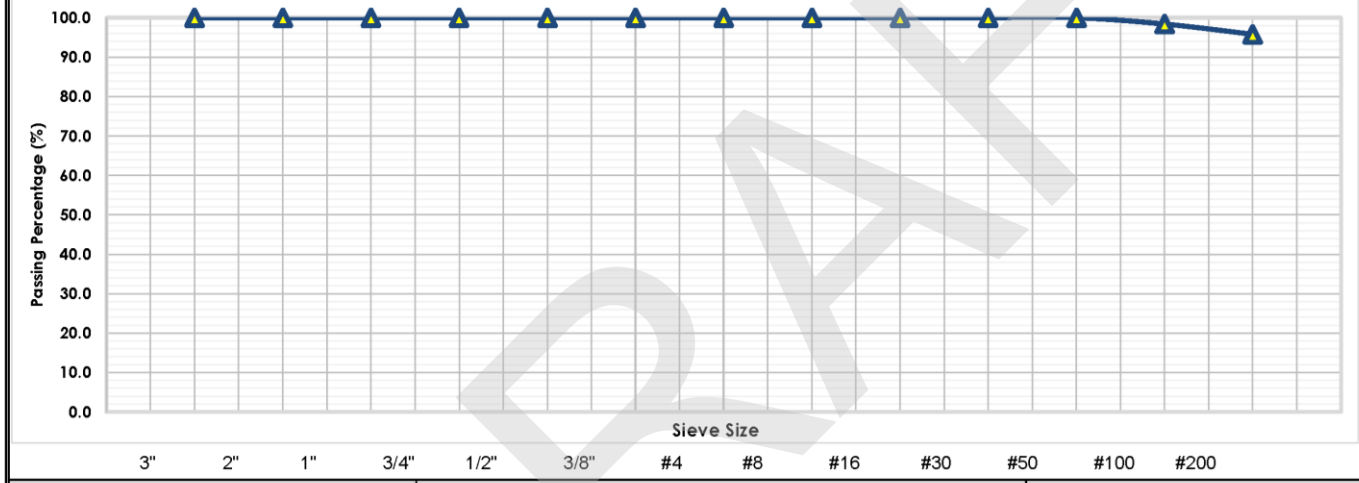
DRAFT

ASIAN GEOMATS

www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Railway Phatak Khairpur.		
Borehole No:	3	**Sample No :**	1
Depth (ft) :	5.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	98.4
0.075	95.8

Gravel %	Sand %	Silt & Clay %
0	4	96

Tested By :

Checked By:

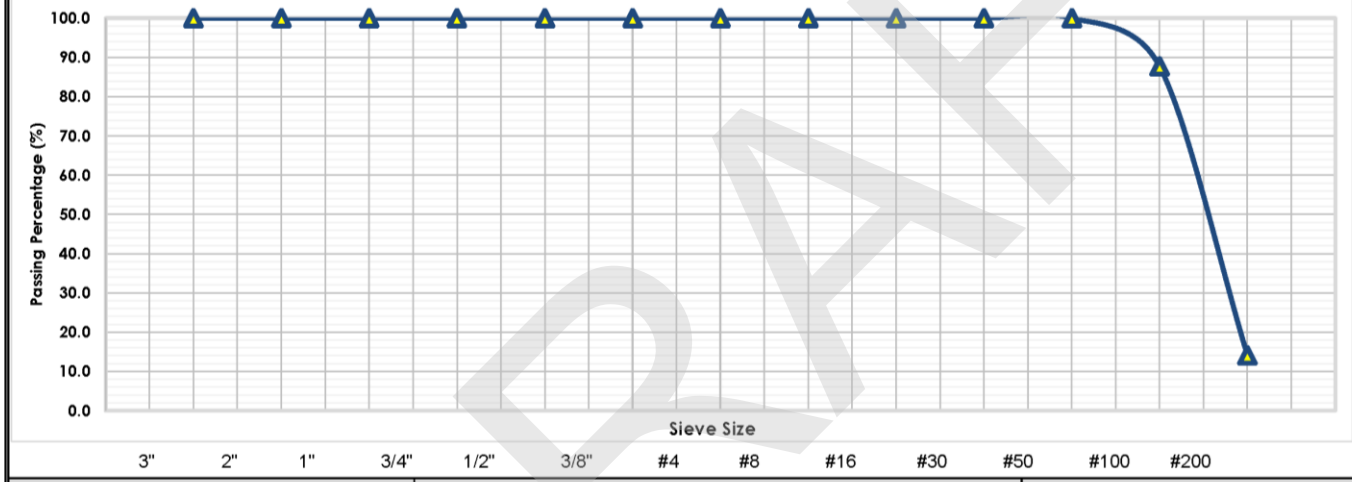
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ASIAN GEOMATS

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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Railway Phatak Khairpur.		
Borehole No:	3	**Sample No :**	2
Depth (ft) :	10.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	87.7
0.075	14.1

Gravel %	Sand %	Silt & Clay %
0	86	14

Tested By :

Checked By:

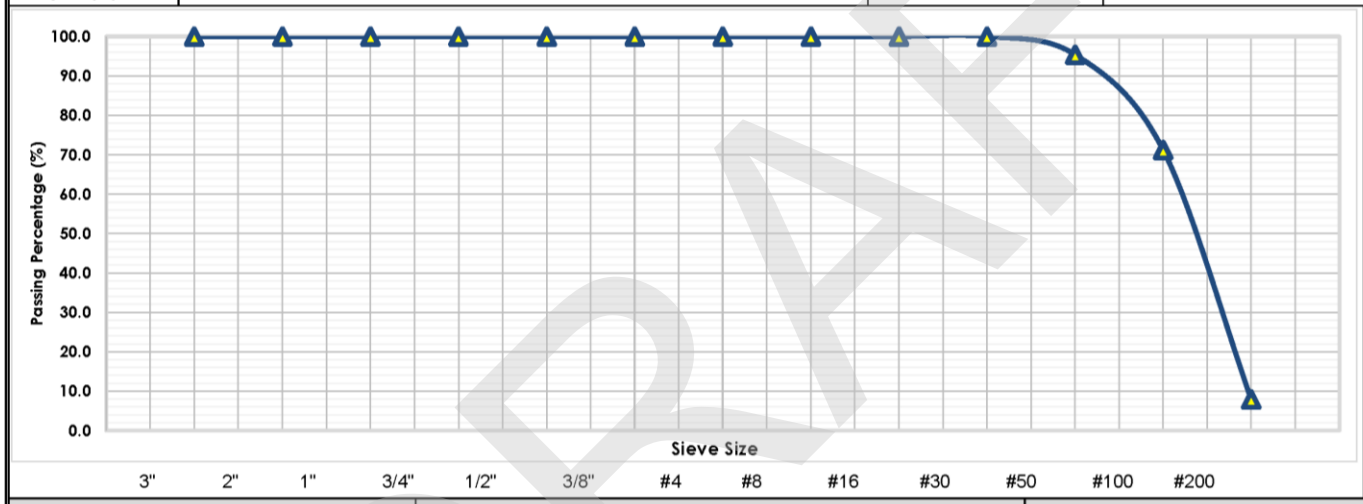
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ASIAN GEOMATS

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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Railway Phatak Khairpur.		
Borehole No:	3	**Sample No :**	4
Depth (ft) :	20.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.4
0.15	71.2
0.075	7.9

Gravel %	Sand %	Silt & Clay %
0	92	8

Tested By :

Checked By:

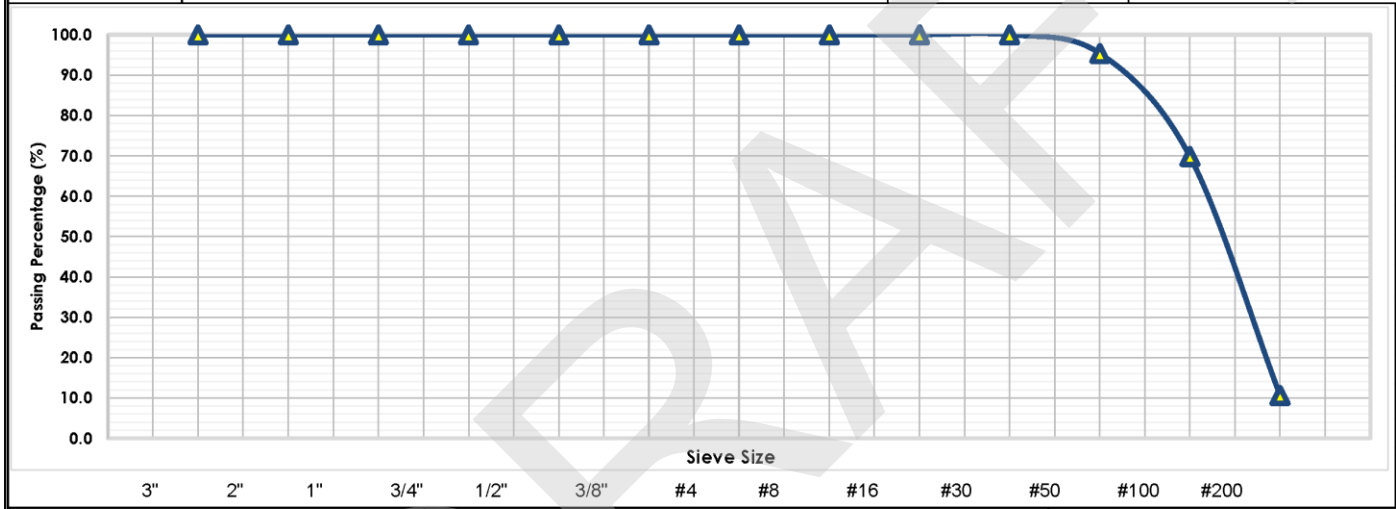
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ASIAN GEOMATS

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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Railway Phatak Khairpur.		
Borehole No:	3	**Sample No :**	6
Depth (ft) :	30.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.4
0.15	69.8
0.075	10.6

Gravel %	Sand %	Silt & Clay %
0	89	11

Tested By :

Checked By:

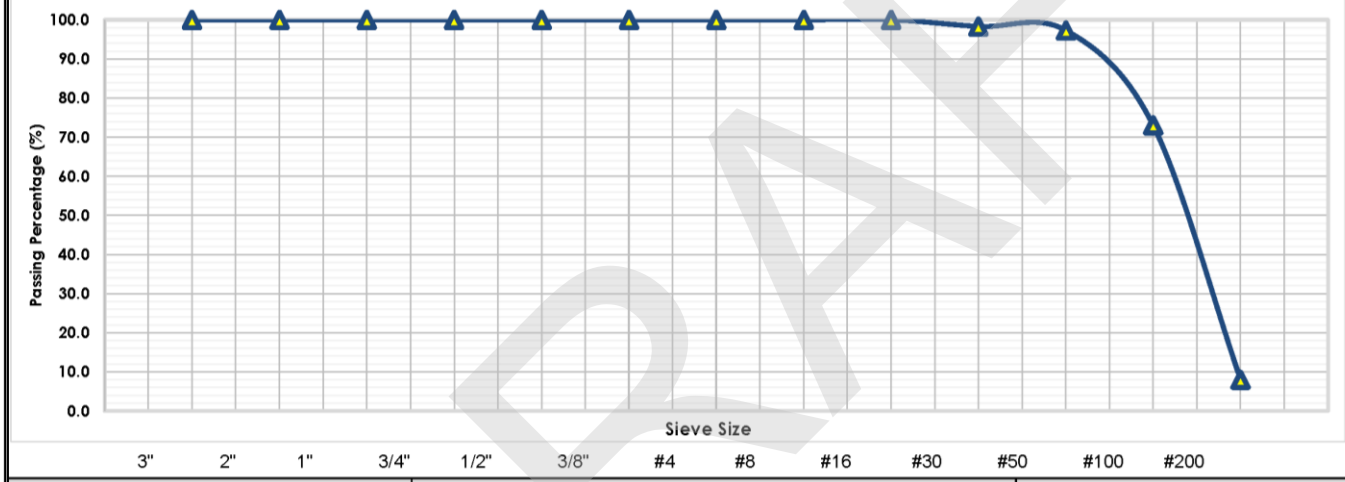
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ASIAN GEOMATS

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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Railway Phatak Khairpur.		
Borehole No:	3	**Sample No :**	8
Depth (ft) :	40.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	98.3
0.3	97.3
0.15	73.0
0.075	8.0

Gravel %	Sand %	Silt & Clay %
0	92	8

Tested By :

Checked By:

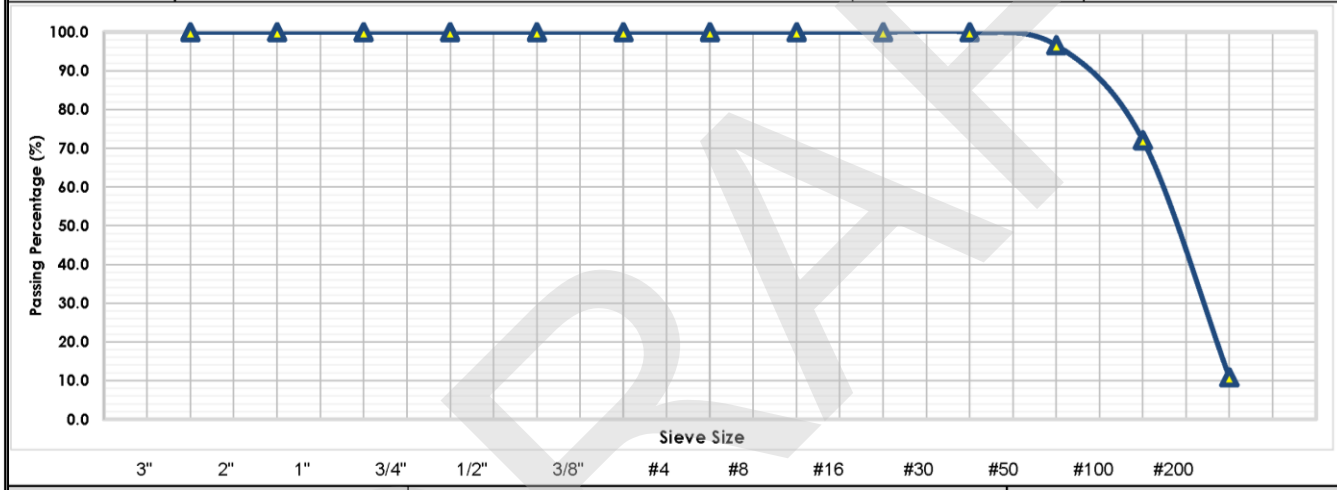
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ASIAN GEOMATS

www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Railway Phatak Khairpur.		
Borehole No:	3	**Sample No :**	10
Depth (ft) :	50.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	96.6
0.15	72.1
0.075	10.8

Gravel %	Sand %	Silt & Clay %
0	89	11

Tested By :

Checked By:

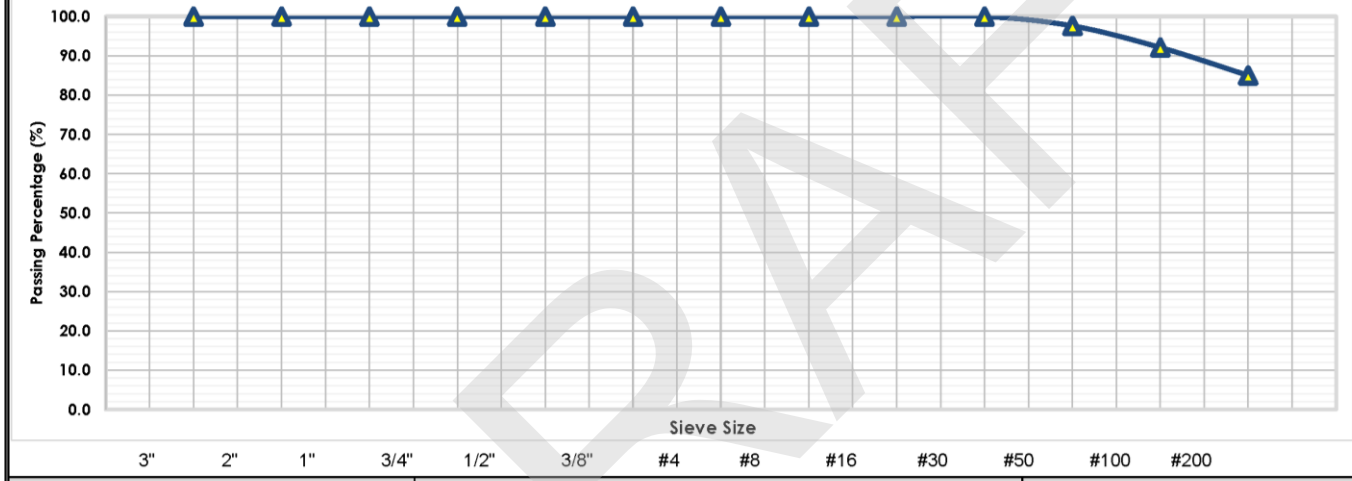
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ASIAN GEOMATS

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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Mirwah Canal Road Khairpur.		
Borehole No:	4	**Sample No :**	1
Depth (ft) :	5.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	97.6
0.15	92.1
0.075	85.0

Gravel %	Sand %	Silt & Clay %
0	15	85

Tested By :

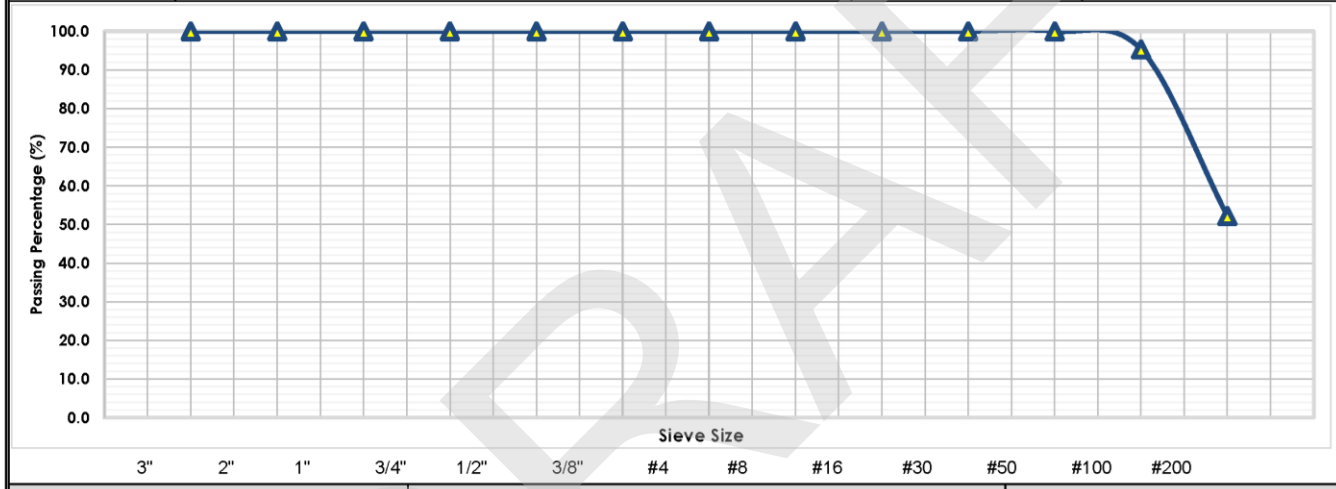
Checked By:

DRAFT

ASIAN GEOMATS

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Mirwah Canal Road Khairpur.		
Borehole No:	4	**Sample No :**	2
Depth (ft) :	10.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	95.3
0.075	52.2

Gravel %	Sand %	Silt & Clay %
0	48	52

Tested By :

Checked By:

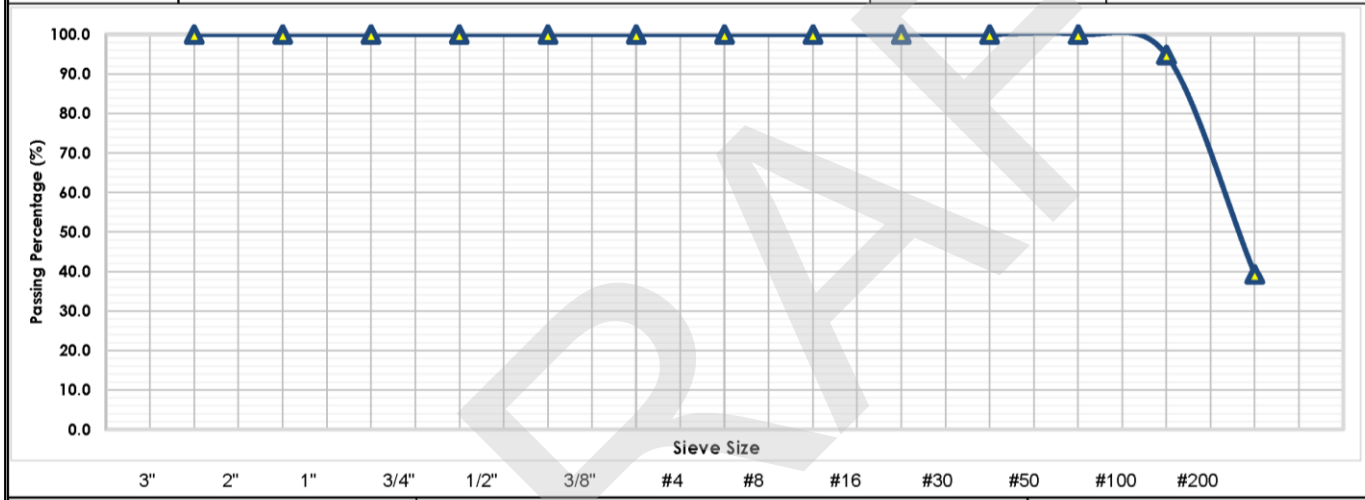
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ASIAN GEOMATS

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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Mirwah Canal Road Khairpur.		
Borehole No:	4	**Sample No :**	4
Depth (ft) :	20.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	94.8
0.075	39.3

Gravel %	Sand %	Silt & Clay %
0	61	39

Tested By :

Checked By:

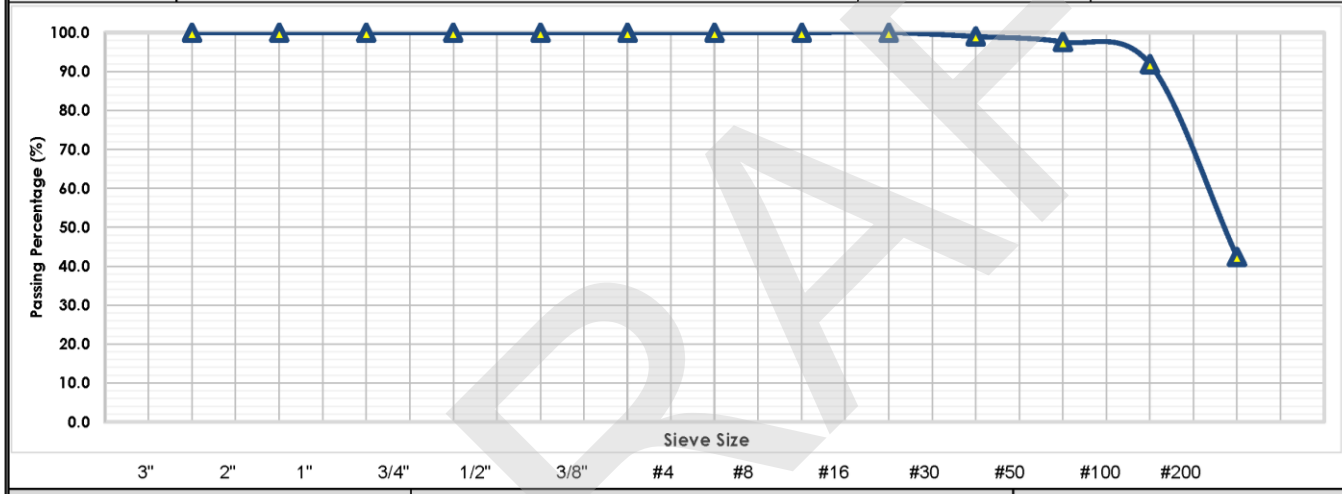
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Mirwah Canal Road Khairpur.		
Borehole No:	4	**Sample No :**	6
Depth (ft) :	30.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	99.0
0.3	97.6
0.15	91.9
0.075	42.4

Gravel %	Sand %	Silt & Clay %
0	58	42

Tested By :

Checked By:

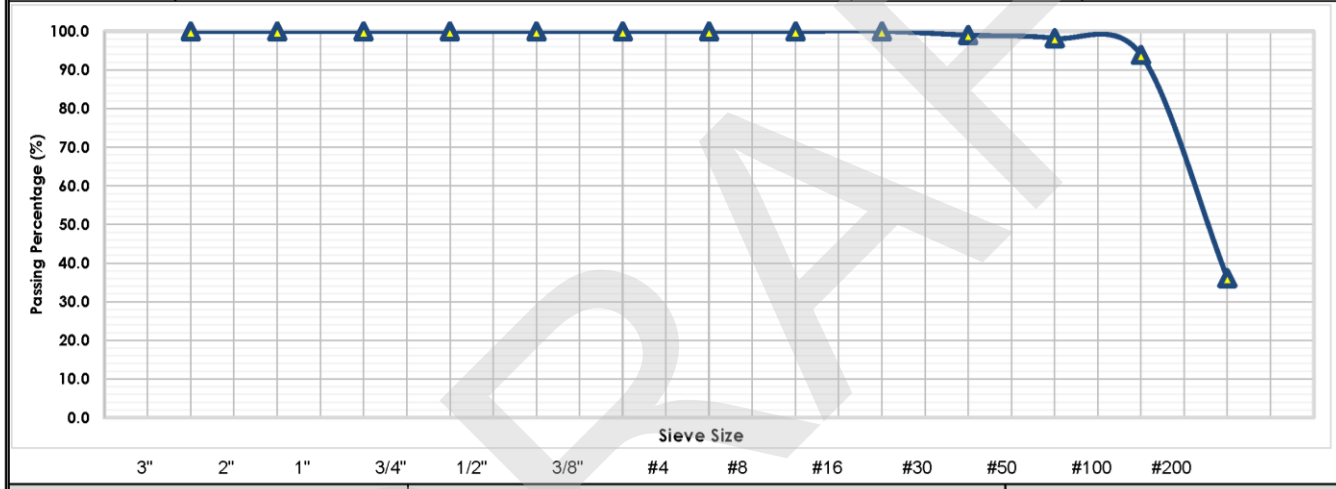
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ASIAN GEOMATS

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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Mirwah Canal Road Khairpur.		
Borehole No:	4	**Sample No :**	8
Depth (ft) :	40.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	99.0
0.3	98.2
0.15	93.9
0.075	36.1

Gravel %	Sand %	Silt & Clay %
0	64	36

Tested By :

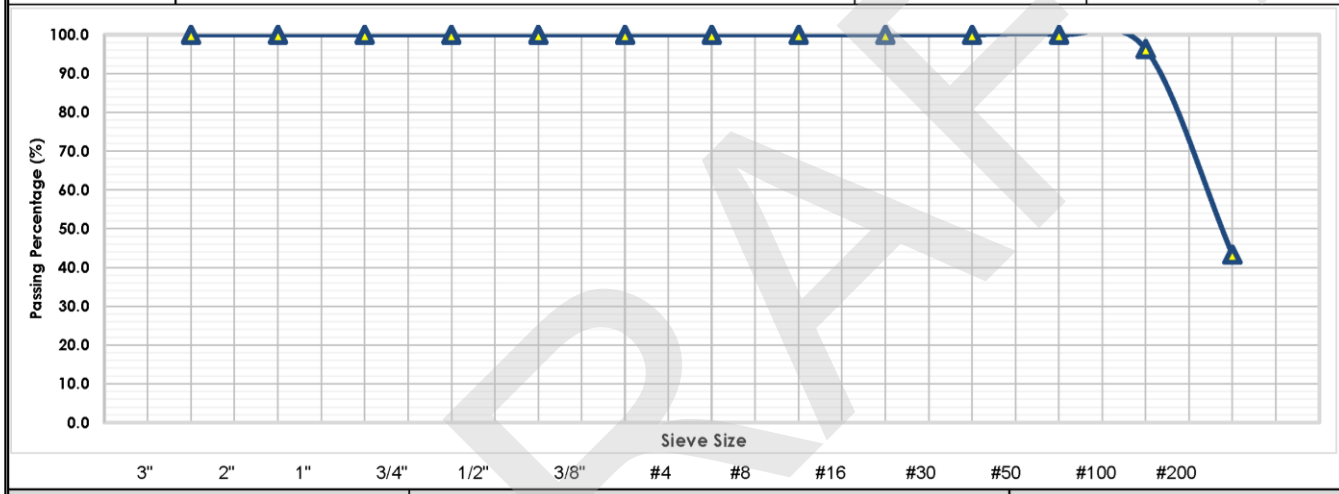
Checked By:

DRAFT

ASIAN GEOMATS

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Mirwah Canal Road Khairpur.		
Borehole No:	4	**Sample No :**	10
Depth (ft) :	50.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	96.3
0.075	43.3

Gravel %	Sand %	Silt & Clay %
0	57	43

Tested By :

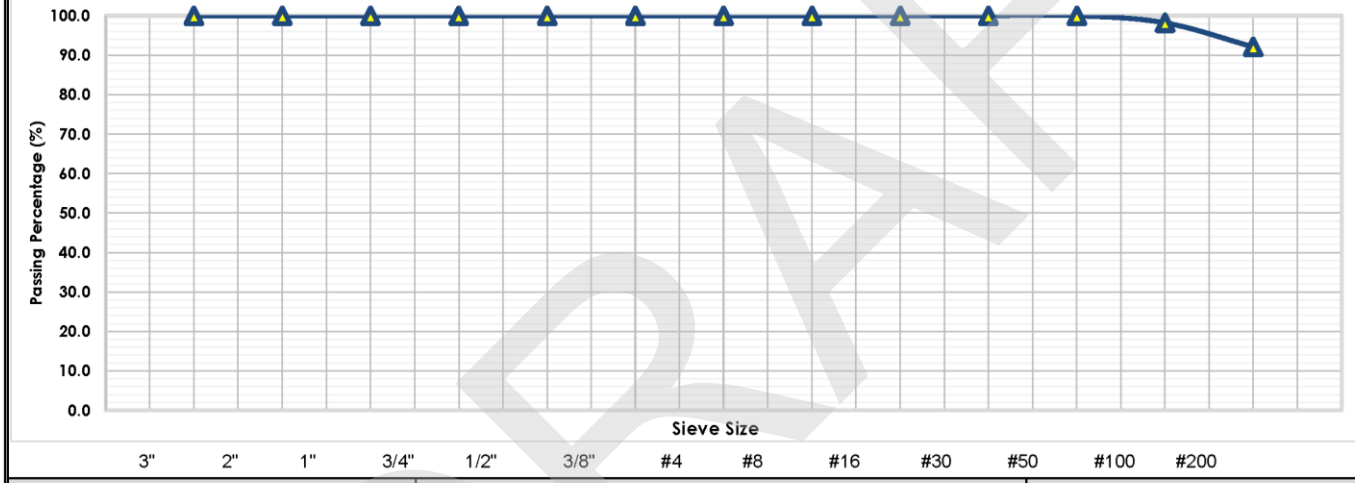
Checked By:

DRAFT

ASIAN GEOMATS

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Underpass Khairpur.		
Borehole No:	5	**Sample No :**	1
Depth (ft) :	5.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	98.2
0.075	92.1

Gravel %	Sand %	Silt & Clay %
0	8	92

Tested By :

Checked By:

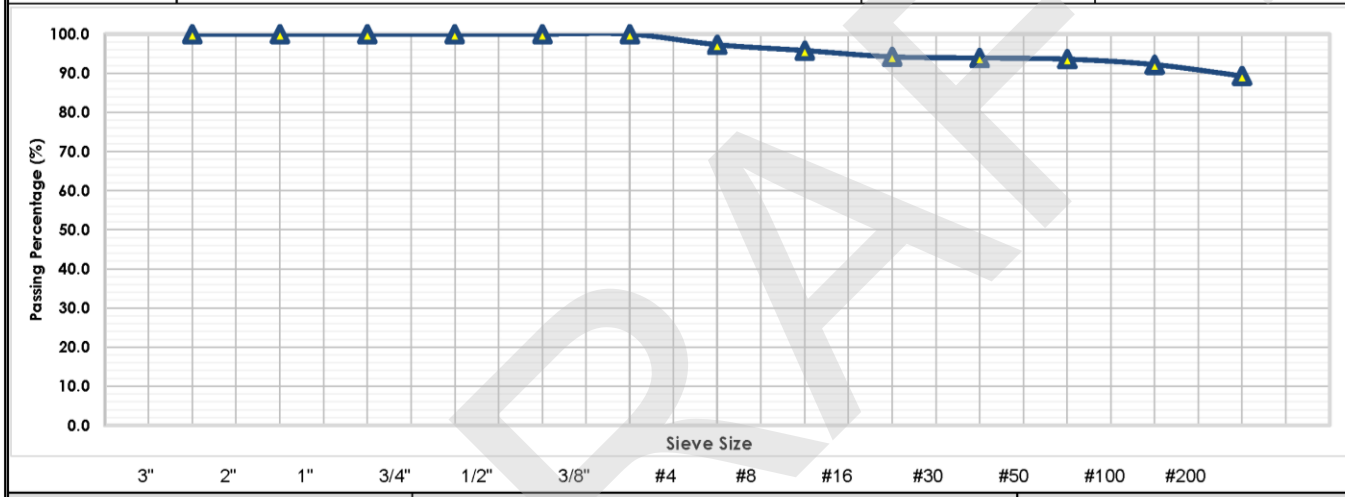
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ASIAN GEOMATS

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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Underpass Khairpur.		
Borehole No:	5	**Sample No :**	2
Depth (ft) :	10.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	97.3
2.36	95.8
1.18	94.2
0.6	93.9
0.3	93.6
0.15	92.2
0.075	89.3

Gravel %	Sand %	Silt & Clay %
3	8	89

Tested By :

Checked By:

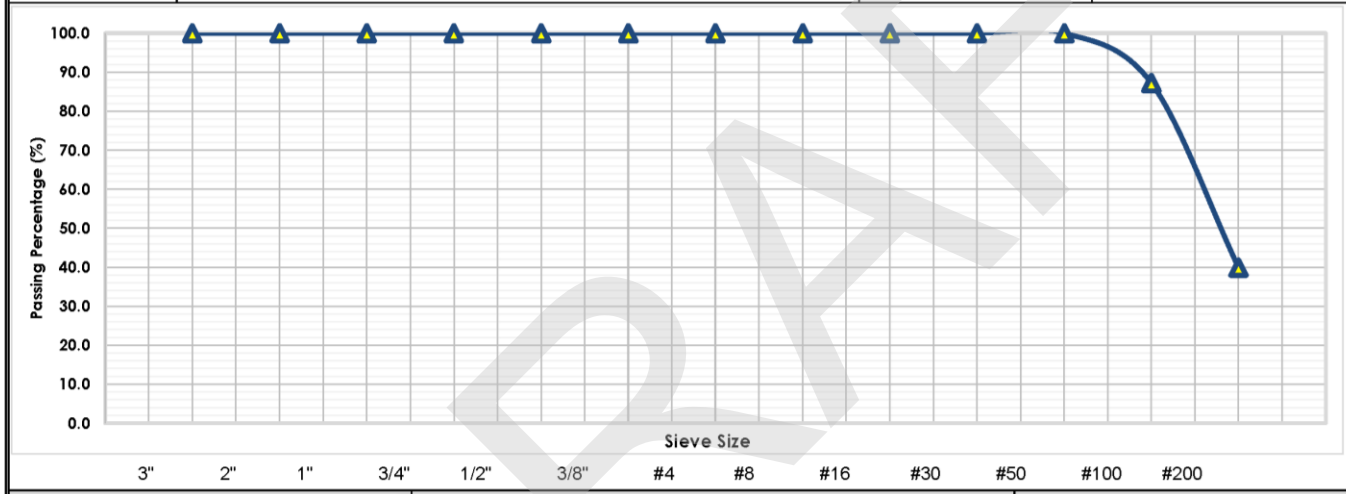
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Underpass Khairpur.		
Borehole No:	5	**Sample No :**	3
Depth (ft) :	15.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	87.2
0.075	39.9

Gravel %	Sand %	Silt & Clay %
0	60	40

Tested By :

Checked By:

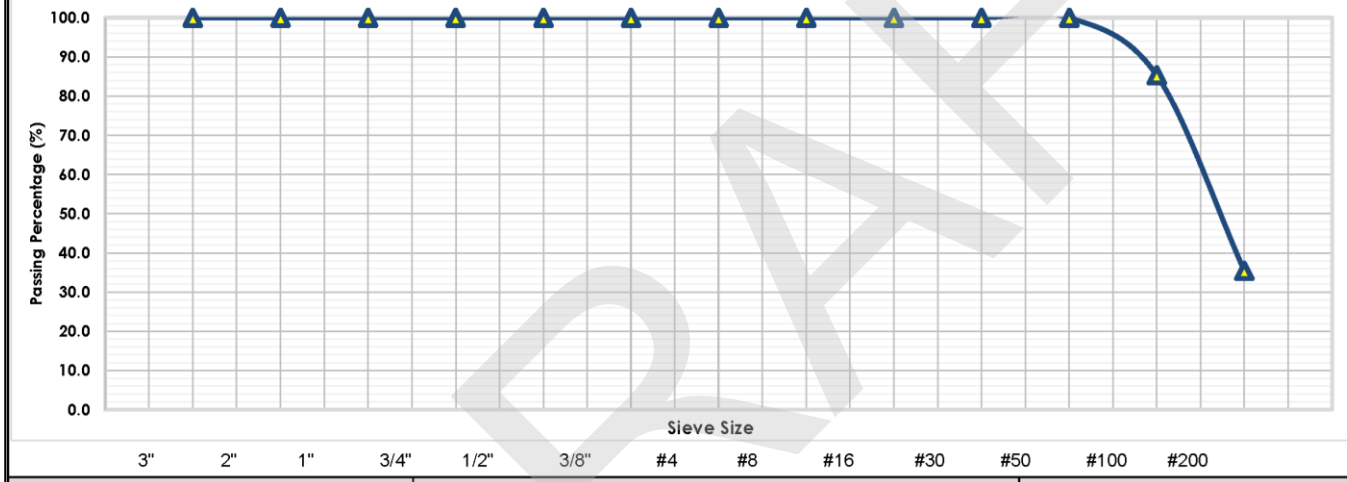
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Underpass Khairpur.		
Borehole No:	5	**Sample No :**	4
Depth (ft) :	20.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	100.0
0.15	85.3
0.075	35.4

Gravel %	Sand %	Silt & Clay %
0	65	35

Tested By :

Checked By:

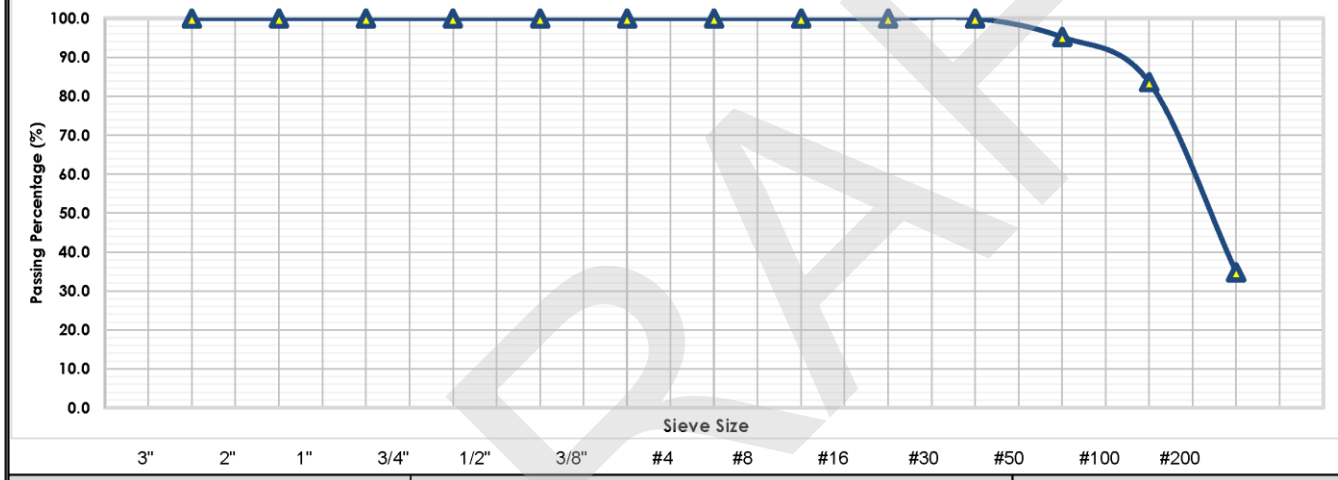
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www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Underpass Khairpur.		
Borehole No:	5	**Sample No :**	6
Depth (ft) :	30.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.2
0.15	83.6
0.075	34.8

Gravel %	Sand %	Silt & Clay %
0	65	35

Tested By :

Checked By:

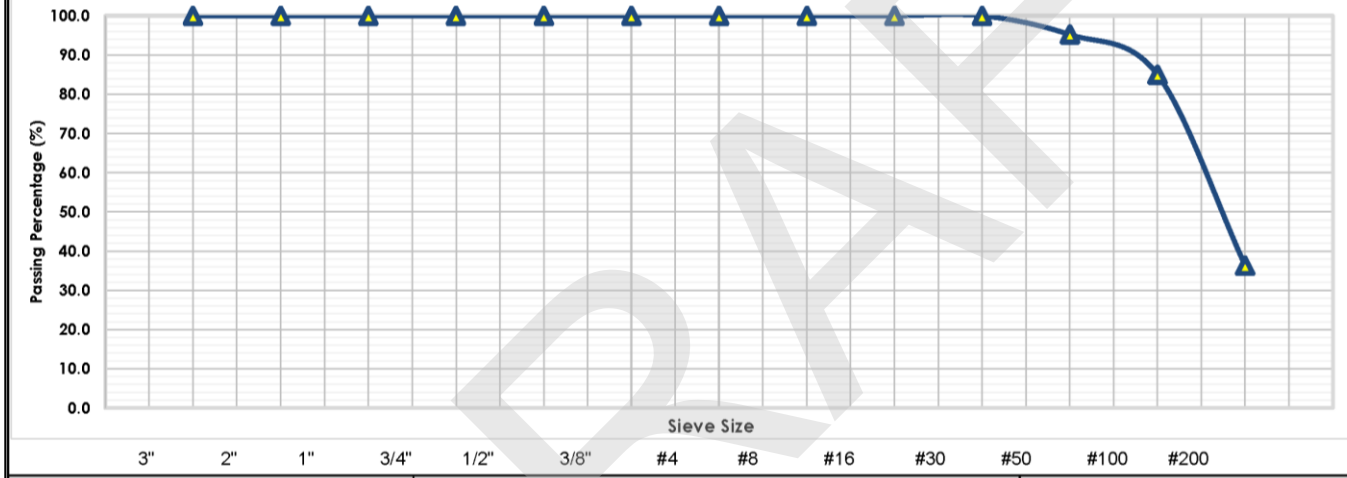
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ASIAN GEOMATS

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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Underpass Khairpur.		
Borehole No:	5	**Sample No :**	8
Depth (ft) :	40.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.2
0.15	85.0
0.075	36.3

Gravel %	Sand %	Silt & Clay %
0	64	36

Tested By :

Checked By:

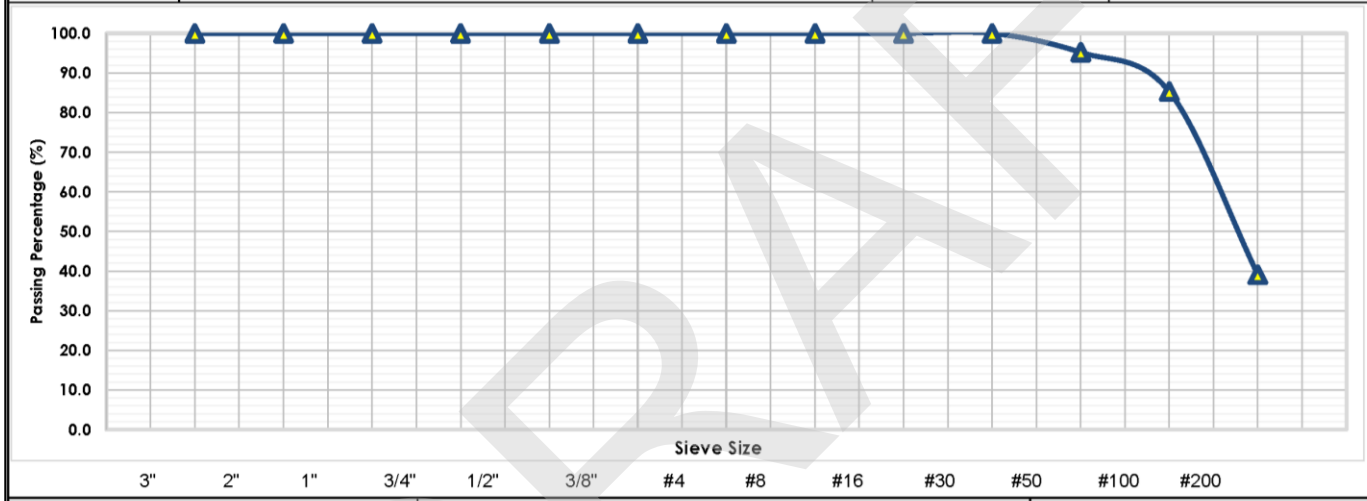
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ASIAN GEOMATS

www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Near Underpass Khairpur.		
Borehole No:	5	**Sample No :**	10
Depth (ft) :	50.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.2
0.15	85.3
0.075	39.1

Gravel %	Sand %	Silt & Clay %
0	61	39

Tested By :

Checked By:

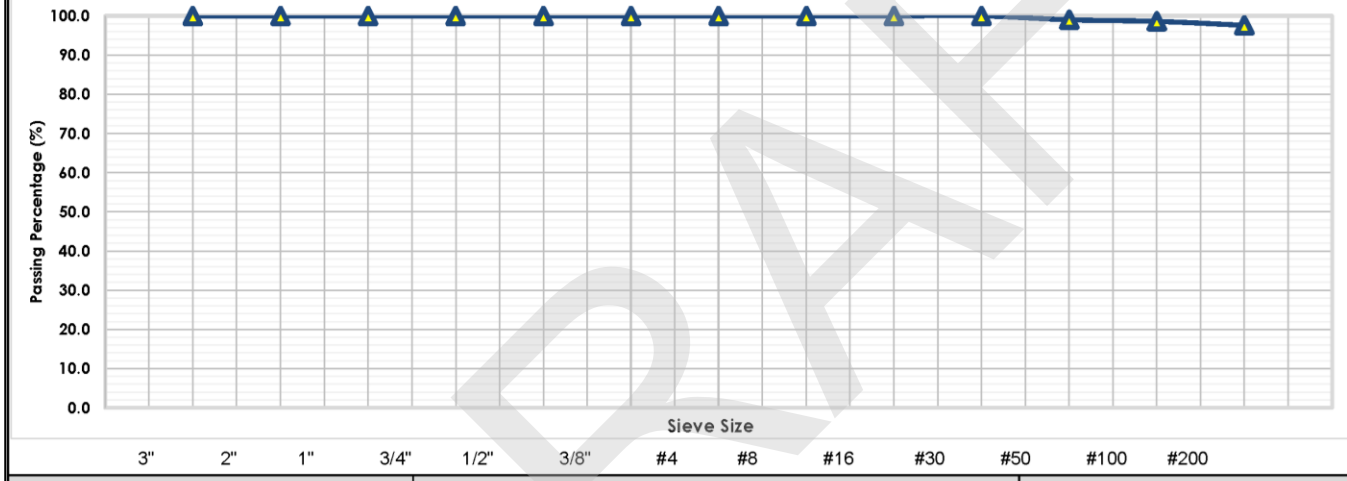
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ASIAN GEOMATS

www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Front Wapda Office Khairpur.		
Borehole No:	6	**Sample No :**	1
Depth (ft) :	5.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	99.0
0.15	98.6
0.075	97.6

Gravel %	Sand %	Silt & Clay %
0	2	98

Tested By :

Checked By:

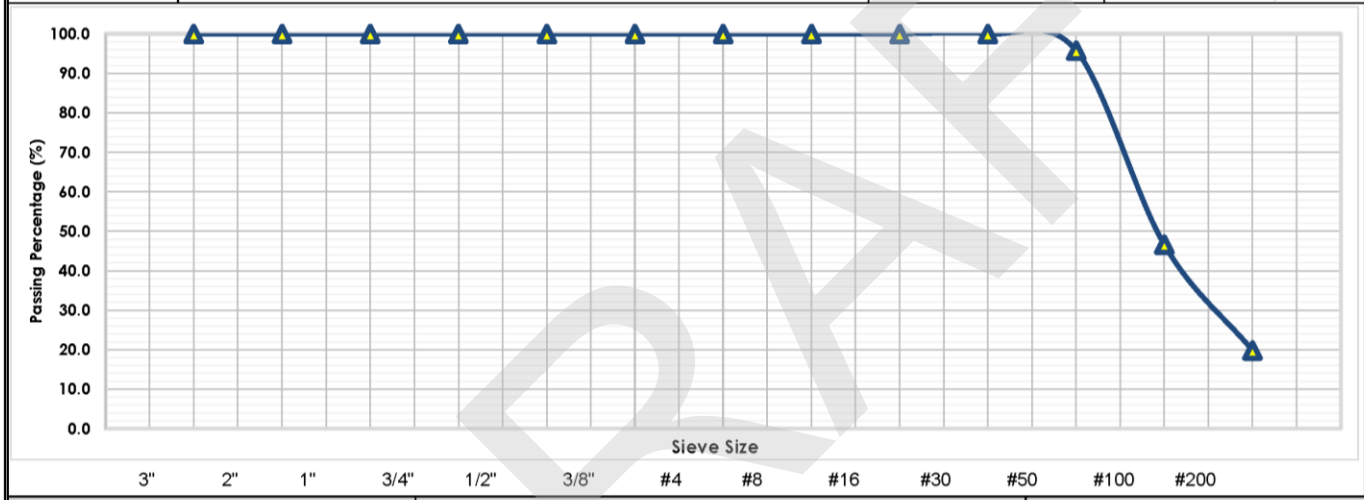
DRAFT

ASIAN GEOMATS

www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Front Wapda Office Khairpur.		
Borehole No:	6	**Sample No :**	2
Depth (ft) :	10.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.8
0.15	46.6
0.075	19.8

Gravel %	Sand %	Silt & Clay %
0	80	20

Tested By :

Checked By:

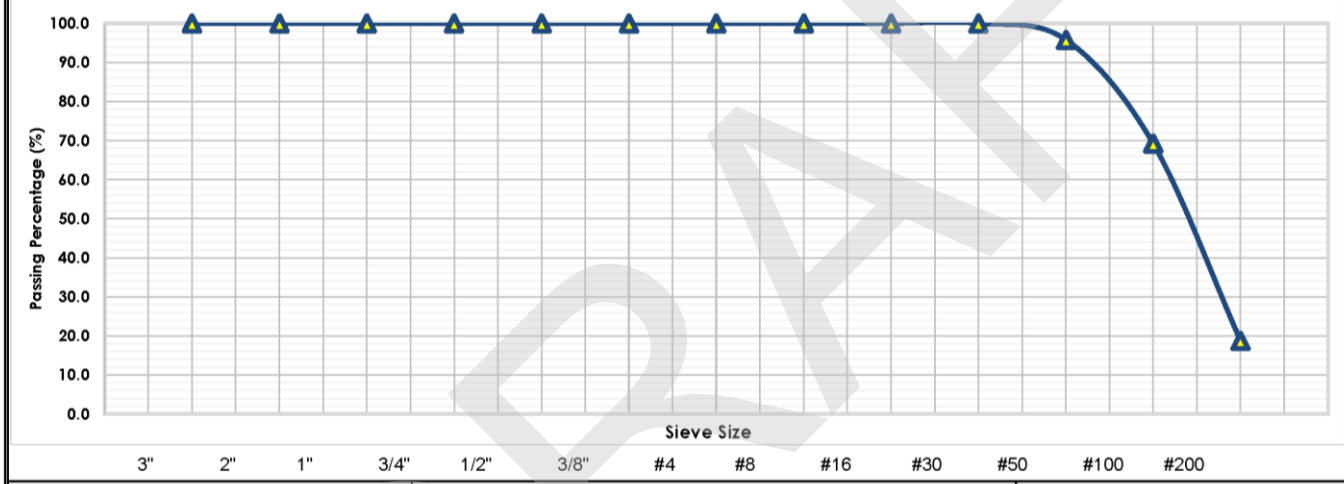
DRAFT

ASIAN GEOMATS

www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Front Wapda Office Khairpur.		
Borehole No:	6	**Sample No :**	3
Depth (ft) :	15.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.8
0.15	69.2
0.075	18.7

Gravel %	Sand %	Silt & Clay %
0	81	19

Tested By :

Checked By:

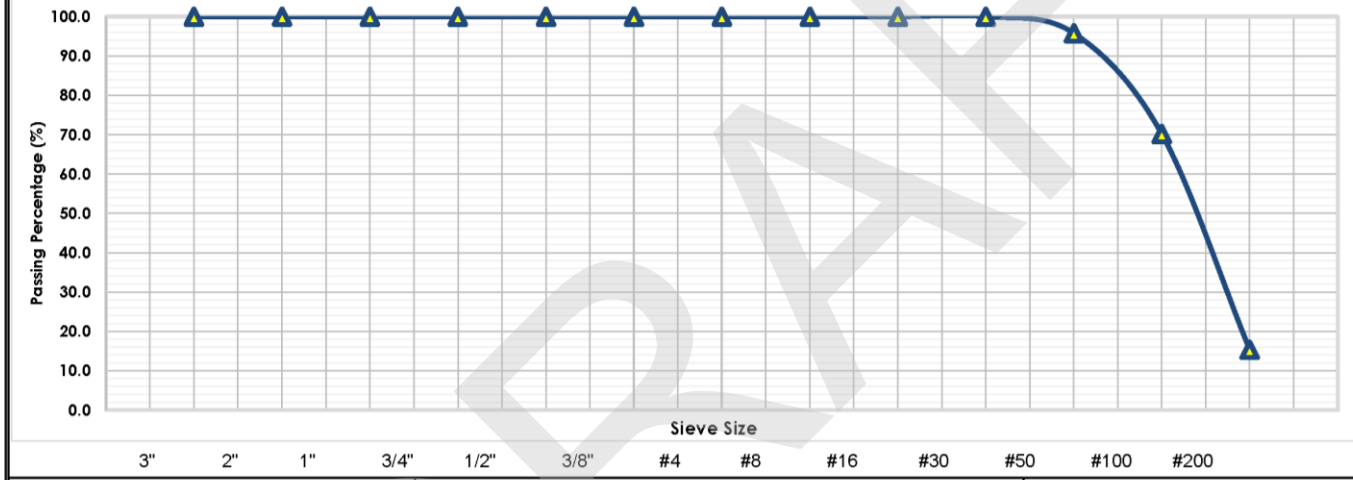
DRAFT

ASIAN GEOMATS

www.asiangeomats.com

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Front Wapda Office Khairpur.		
Borehole No:	6	**Sample No :**	4
Depth (ft) :	20.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.8
0.15	70.2
0.075	15.3

Gravel %	Sand %	Silt & Clay %
0	85	15

Tested By :

Checked By:

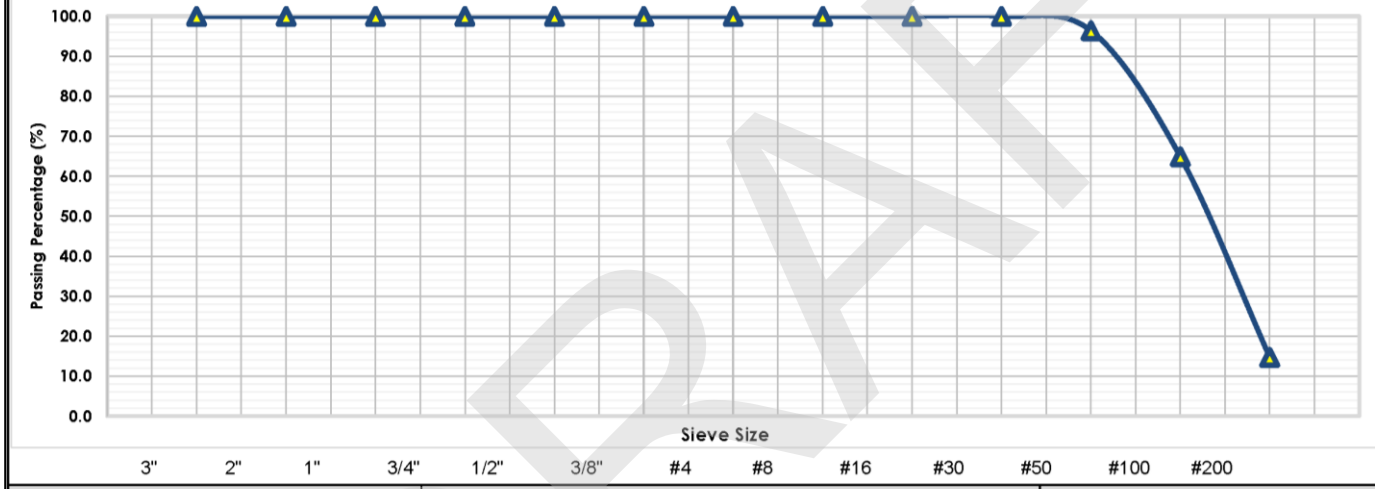
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Front Wapda Office Khairpur.		
Borehole No:	6	**Sample No :**	6
Depth (ft) :	30.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	96.4
0.15	64.9
0.075	14.7

Gravel %	Sand %	Silt & Clay %
0	85	15

Tested By :

Checked By:

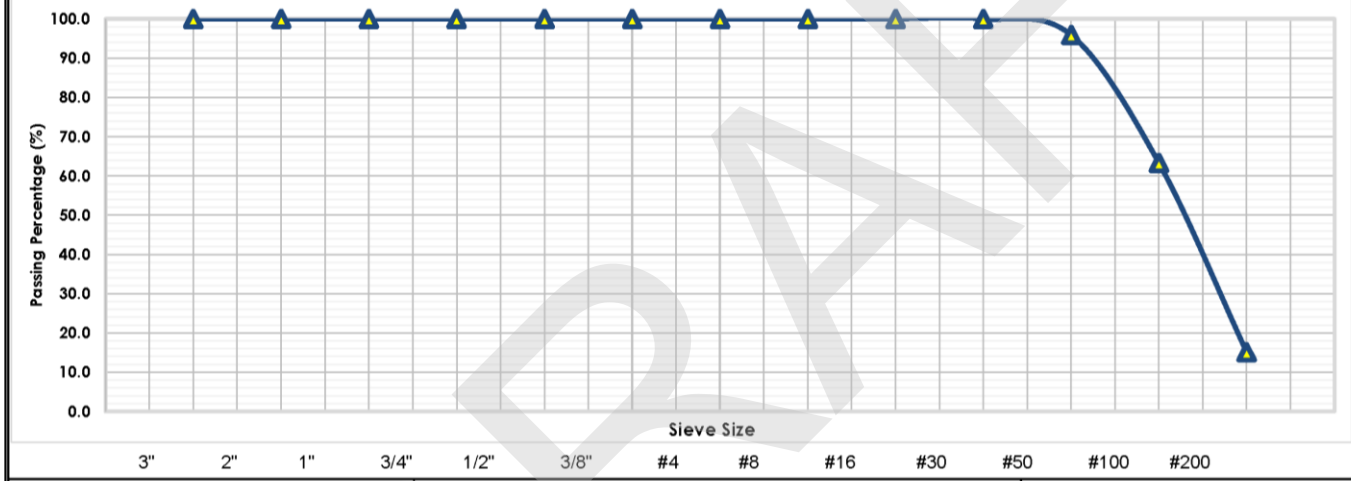
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Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Front Wapda Office Khairpur.		
Borehole No:	6	**Sample No :**	8
Depth (ft) :	40.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	95.9
0.15	63.3
0.075	15.1

Gravel %	Sand %	Silt & Clay %
0	85	15

Tested By :

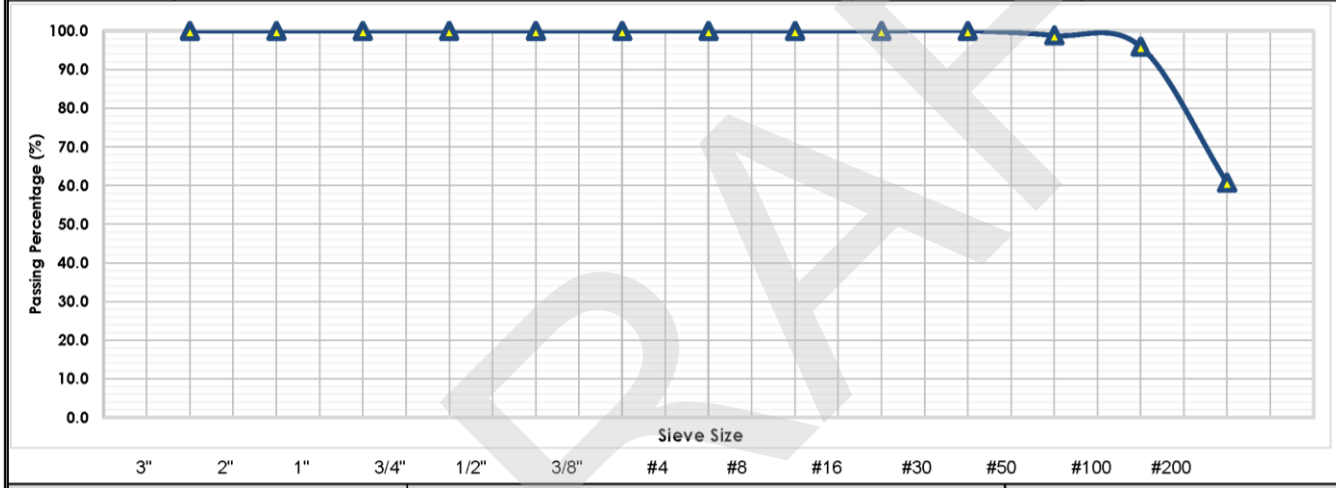
Checked By:

DRAFT

ASIAN GEOMATS

Grain Size Analysis (AASHTO T-89,90)(ASTM D-208,209,210)

Project :	Front Wapda Office Khairpur.		
Borehole No:	6	**Sample No :**	10
Depth (ft) :	50.0	**Date :**	29/07/2025



Sieve Size Inch/No	Passing % age
3"	100.0
2"	100.0
1"	100.0
3/4"	100.0
1/2"	100.0
3/8"	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	100.0
0.3	98.8
0.15	95.9
0.075	60.7

Gravel %	Sand %	Silt & Clay %
0	39	61

Tested By :

Checked By:

DRAFT

D. Pictures


ASIAN GEOMATS
nbp ehsa
om kirya
GD Siming
Google
7/22/25 12:16
27.5497N 68.7368E
Altitude:69.1m
Speed:0.0km/h
#BH-1 #khairpur Sindh pakistan


ASIAN
GEOMATS
7/23/25 15:40
27.5114N 68.7223E
Sindh
Altitude:88.1m
Speed:0.0km/h
#BH-02 #khairpur Sindh pakistan
Google


ASIAN GEOMATS
Ali shah bukhari
Rohri Canal
Mirwah Canal Rd 2
Google
7/22/25 09:41
27.5628N 68.7536E
Sindh
Altitude:62.2m
Speed:1.4km/h
#khairpur Sindh pakistan #BH-04


ASIAN GEOMATS
Mirwah Canal Rd 2
Google
7/22/25 09:42
27.5628N 68.7535E
Sindh
Altitude:66.9m
Speed:0.0km/h
#khairpur Sindh pakistan #BH-04

E. Summary

ASIAN GEOMATS

Summary Sheet of Laboratory Test Results

Project : Rohri Canal Road Khairpur.

BH No.	Depth (ft)	Sample	Soil Strata			Atteberg,s Limits			Soil Classification	
			Gravel (%)	Sand (%)	Silt & Clay (%)	LL	PL	PI	Group Symbol	Group Name
1	5	SPT-1	0	3	97	27.6	21.2	6.4	CL-ML	Silty Clay
	10	SPT-2	0	3	97	27.6	21.2	6.4	CL-ML	Silty Clay
	15	SPT-3	0	7	93	27.1	21.1	6.0	CL-ML	Silty Clay
	20	SPT-4	0	5	95	27.4	21.1	6.3	CL-ML	Silty Clay
	30	SPT-6	0	70	30	Non Plastic			SM	Silty Sand
	40	SPT-8	0	94	6	Non Plastic			SP-SM	Poorly graded Sand with Silt
	50	SPT-10	0	92	8	Non Plastic			SP-SM	Poorly graded Sand with Silt

Tested By Checked by

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ASIAN GEOMATS

www.asiangeomats.com

Summary Sheet of Laboratory Test Results

Project : Rohri Canal Road Khairpur.

BH No.	Depth (ft)	Sample	Soil Strata			Atteberg,s Limits			Soil Classification	
			Gravel (%)	Sand (%)	Silt & Clay (%)	LL	PL	PI	Group Symbol	Group Name
2	5	SPT-1	0	92	8	Non Plastic			SP-SM	Poorly graded Sand with Silt
	10	SPT-2	0	91	9	Non Plastic			SP-SM	Poorly graded Sand with Silt
	20	SPT-4	0	94	6	Non Plastic			SP-SM	Poorly graded Sand with Silt
	30	SPT-6	0	93	7	Non Plastic			SP-SM	Poorly graded Sand with Silt
	40	SPT-8	0	91	9	Non Plastic			SP-SM	Poorly graded Sand with Silt
	50	SPT-10	0	94	6	Non Plastic			SP-SM	Poorly graded Sand with Silt

Tested By Checked by

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ASIAN GEOMATS

www.asiangeomats.com

Summary Sheet of Laboratory Test Results

Project : Near Railway Phatak Khairpur.

BH No.	Depth (ft)	Sample	Soil Strata			Atteberg,s Limits			Soil Classification	
			Gravel (%)	Sand (%)	Silt & Clay (%)	LL	PL	PI	Group Symbol	Group Name
3	5	SPT-1	0	4	96	27.5	21.2	6.3	CL-ML	Silty Clay
	10	SPT-2	0	86	14	Non Plastic			SM	Silty Sand
	20	SPT-4	0	92	8	Non Plastic			SP-SM	Poorly graded Sand with Silt
	30	SPT-6	0	89	11	Non Plastic			SP-SM	Poorly graded Sand with Silt
	40	SPT-8	0	92	8	Non Plastic			SP-SM	Poorly graded Sand with Silt
	50	SPT-10	0	89	11	Non Plastic			SP-SM	Poorly graded Sand with Silt

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Checked by

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Summary Sheet of Laboratory Test Results

Project : Mirwah Canal Road Khairpur..

BH No.	Depth (ft)	Sample	Soil Strata			Atteberg,s Limits			Soil Classification	
			Gravel (%)	Sand (%)	Silt & Clay (%)	LL	PL	PI	Group Symbol	Group Name
4	5	SPT-1	0	15	85	25.4	21.1	4.3	CL-ML	Silty Clay with Sand
	10	SPT-2	0	48	52	Non Plastic			ML	Sandy Silt
	20	SPT-4	0	61	39	Non Plastic			SM	Silty Sand
	30	SPT-6	0	58	42	Non Plastic			SM	Silty Sand
	40	SPT-8	0	64	36	Non Plastic			SM	Silty Sand
	50	SPT-10	0	57	43	Non Plastic			SM	Silty Sand

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Summary Sheet of Laboratory Test Results

Project : Near Underpass Khairpur.

BH No.	Depth (ft)	Sample	Soil Strata			Atteberg,s Limits			Soil Classification	
			Gravel (%)	Sand (%)	Silt & Clay (%)	LL	PL	PI	Group Symbol	Group Name
5	5	SPT-1	0	8	92	26.8	21.2	5.6	CL-ML	Silty Clay
	10	SPT-2	3	8	89	26.8	21.2	5.6	CL-ML	Silty Clay
	15	SPT-3	0	60	40	Non Plastic			SM	Silty Sand
	20	SPT-4	0	65	35	Non Plastic			SM	Silty Sand
	30	SPT-6	0	65	35	Non Plastic			SM	Silty Sand
	40	SPT-8	0	64	36	Non Plastic			SM	Silty Sand
	50	SPT-10	0	61	39	Non Plastic			SM	Silty Sand

Tested By

Checked by

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ASIAN GEOMATS

www.asiangeomats.com

Summary Sheet of Laboratory Test Results

Project : Near Underpass Khairpur.

BH No.	Depth (ft)	Sample	Soil Strata			Atteberg,s Limits			Soil Classification	
			Gravel (%)	Sand (%)	Silt & Clay (%)	LL	PL	PI	Group Symbol	Group Name
6	5	SPT-1	0	2	98	28.1	21.3	6.8	CL-ML	Silty Clay
	10	SPT-2	0	80	20	Non Plastic			SM	Silty Sand
	15	SPT-3	0	81	19	Non Plastic			SM	Silty Sand
	20	SPT-4	0	85	15	Non Plastic			SM	Silty Sand
	30	SPT-6	0	85	15	Non Plastic			SM	Silty Sand
	40	SPT-8	0	85	15	Non Plastic			SM	Silty Sand
	50	SPT-10	0	39	61	Non Plastic			ML	Sandy Silt

Tested By

Checked by

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